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ESE 2020

Preliminary Examination

Detailed Solutions of

Electronics & Telecom Engg.

(Set-A)

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Expected Cutoff of ESE 2020 Prelims (Out of 500 Marks)					Actual Cutoff of ESE 2019 Prelims (Out of 500 Marks)				
Branch	**Gen**	**OBC**	**SC**	**ST**	**Branch**	**Gen**	**OBC**	**SC**	**ST**
CE	210-220	205-215	170-180	170-180	**CE**	188	185	143	159
ME	245-255	245-255	210-220	210-220	**ME**	187	187	166	169
EE	225-235	215-225	195-205	195-205	**EE**	221	211	191	172
E&T	235-245	225-235	185-195	185-195	**E&T**	226	221	176	165

E&T Paper Analysis
ESE 2020 Prelims Exam

Sl.	Subjects	Number of Questions
1	Materials Science	10
2	Electronic Devices and Circuits	2
3	Analog Circuits	12
4	Network Theory	20
5	Control Systems	11
6	Electromagnetic Theory	11
7	Measurements	12
8	Communication Systems	16
9	Advance Communications	10
10	Advance Electronics	5
11	Basic Electrical Engineering	8
12	Computer Organization	11
13	Signals and Systems	9
14	Digital Circuits	9
15	Microprocessors	4

1. 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

Ans. (a)

$$V_m = 35\sqrt{2}$$

$$I_{DC} R_L = V_m - \frac{I_{DC}}{4f_o C}$$

$$I_{DC}\left[R_L + \frac{1}{4f_o C}\right] = V_m$$

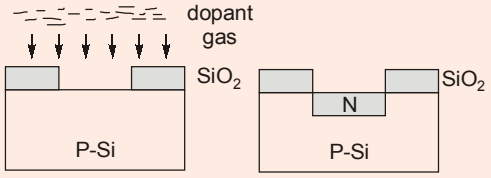
$$I_{DC} = \frac{35\sqrt{2}}{375} = 132\,\text{mA}$$

End of Solution

2. Silicon dioxide (SiO_2) is used in *IC*s, because it

(a) Facilitates the penetration of diffusants
(b) Has high heat conduction
(c) Prevents diffusion of impurities
(d) Controls the concentration of diffusants

Ans. (c)



SiO_2 is mask against diffusion.

End of Solution

3. Consider an *n*-channel MOSFET with parameters:
K_n = 0.25 mA/V^2, V_{TN} = 1 V, λ = 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

Ans. (c)

$$g_m = 2k_n (V_{GS} - V_T)$$
$$= 2 \times 0.25 \times 2 = 1\ \text{m℧}$$

$$f_T = \frac{g_m}{2\pi(C_{gs} + C_{gd})} = \frac{1\times10^{-3}}{2\pi\times0.24\times10^{-12}}$$

$$= \frac{1\times10^{9}}{1.5079} = 663\,\text{MHz}$$

End of Solution

4. The voltage gain of *CE* amplifier circuit can be approximated for an ideal input ac source and is given by

(a) $A_{Vs} = \dfrac{r_e'}{(R_C \times R_L)}$

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

(c) $A_{Vs} = -\dfrac{(R_C \parallel R_L)}{r_e'}$

(d) $A_{Vs} = \dfrac{(R_C \times R_L)}{r_e'}$

where: R_L = Load resistance
R_C = Collector resistance
r_e' = Effective resistance at input of transistor from emitter resistance R_E

Ans. **(c)**

End of Solution

5. 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

Ans. **(a)**

End of Solution

6. 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

Ans. **(c)**

End of Solution

7. 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

Ans. **(c)**

$$A_{CL} = 200 \times 10^3 \text{ V/V}$$

$$\text{Cut-off frequency } (f_c) = \frac{\text{Unity gain BW}}{A_{CL}} = \frac{10^6}{200 \times 10^3} = 5 \text{ Hz}$$

End of Solution

8. 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

Ans. **(d)**

$$I = C \times \frac{dV}{dt}$$

$$\text{Slew rate} = \frac{dV}{dt} = \frac{I}{C} = \frac{19 \times 10^{-6}}{30 \times 10^{-12}} = 0.63 \text{ V/μsec}$$

End of Solution

9. 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

Ans. **(a)**

End of Solution

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

(a) Input resistance R_i = ∞, output resistance R_o = 0 and bandwidth = 0
(b) Input resistance R_i = 0, output resistance R_o = ∞ and bandwidth = 0
(c) Input resistance R_i = ∞, output resistance R_o = 0 and bandwidth = ∞
(d) Input resistance R_i = 0, output resistance R_o = 0 and bandwidth = ∞

Ans. **(c)**

End of Solution

11. The advantage of ILD over LED is

(a) ILD emits incoherent light whereas 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

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Ans. **(d)**

ILD is Injection laser diode → it is coherent in nature i.e., $\phi = 0°$ or no delay is comp. LED is incoherent.

End of Solution

12. 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

Ans. **(b)**

$$\eta = \frac{\text{generated eletrons/sec}}{\text{incident photons/sec}}$$

$$\eta = \frac{I/q}{P_o/h\nu} = \frac{I_{ph}/e}{P_o/(hc/\lambda)}$$

End of Solution

13. 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

Ans. **(c)**

End of Solution

14. 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

Ans. **(d)**

End of Solution

15. 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

Ans. **(b)**

$$e = Blv$$

$$= 40\times10^{-6}\times2\times72\times\frac{5}{18} = 1.6 \text{ mV}$$

End of Solution

16. 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

Ans. **(a)**

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

End of Solution

17. 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

Ans. **(a)**

$$200 \times 10^3 = 3300 \times I_1$$

$$I_1 = \frac{2000}{33} = 60.6 \text{ A}$$

$$200 \times 10^3 = 240 \times I_2$$

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

End of Solution

18. Consider the following data 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%

Ans. **(b)**

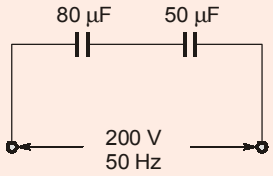
$$P_{in} = VI\cos\phi$$
$$= (230 \times 2.9 \times 0.71) \text{ watt}$$
$$= 473.57 \text{ watt}$$
$$P_{out} = 373 \text{ W}$$
$$\eta = \frac{373}{473.57} \times 100 = 78.76\%$$

End of Solution

19. 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

Ans. **(b)**



$$C_{eq} = \frac{80 \times 50}{80 + 50}\mu\text{F} = 30.769\ \mu\text{F}$$

$$W = \frac{1}{2}C_{eq}V_m^2$$

$$= \frac{1}{2} \times 30.769 \times 10^{-6} \times (200\sqrt{2})^2 = 1.23 \text{ J}$$

End of Solution

20. In a 4-pole dynamo the flux/pole is 15 mWb. 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

Ans. **(d)**

No. of poles = $P = 4$,
Flux (ϕ)/pole = 15 mWb
$N = 600$ rpm

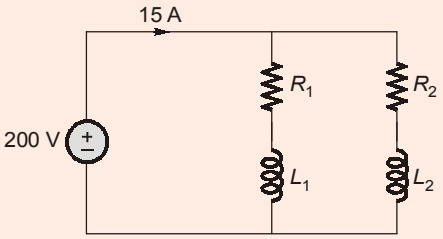
$$\frac{\text{emf}}{\text{conductor}} = \frac{\phi PN}{60} = \frac{15 \times 10^{-3} \times 4 \times 600}{60} = 0.6 \text{ V}$$

End of Solution

21. 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 23.4 Ω
(c) 26.7 Ω and 26.7 Ω (d) 22.4 Ω and 26.7 Ω

Ans. **(c)**



L_1 and L_2 will be short circuited, since DC source is connected.

$$P = \frac{V^2}{R_1} \Rightarrow R_1 = \frac{(200)^2}{1500}$$

$$R_1 = 26.67\ \Omega$$

$$R_{eq} = \frac{V}{I} = \frac{200}{15} = 13.33\ \Omega$$

Also since, $R_{eq} = R_1 \| R_2 = \frac{R_1 R_2}{R_1 + R_2}$

$\therefore$ $R_2 = 26.67\ \Omega$

End of Solution

22. 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

Ans. **(a)**

End of Solution

23. 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

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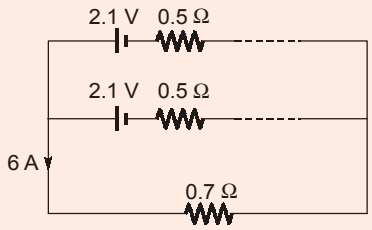
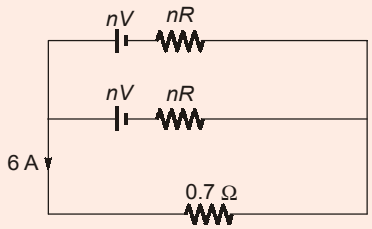
Ans. (c)



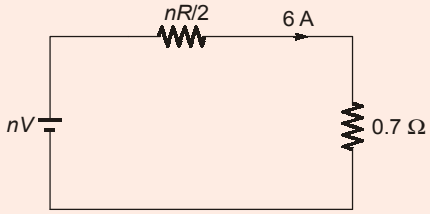
Thevenin equivalent of the circuit

$$V_{Th} = nV$$

$$R_{Th} = \frac{nR}{2}$$



The circuit can be further reduced as



$$V_i = I_i R_i$$

$$nV = 6\left(\frac{nR}{2} + 0.7\right)$$

$$n(2.1) = \frac{3n}{2} + 4.2$$

$$0.6n = 4.2$$

$$n = 7$$

$\therefore$ Total cells will be $n + n = 14$.

End of Solution

24. 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

Ans. **(b)**

Active materials in lead acid cell:

1. Lead peroxide for positive plate.
2. Sponge lead for negative plates.
3. Dilute sulphuric acid (H_2SO_4) as electrolyte.

End of Solution

25. 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

Ans. **(d)**

End of Solution

26. 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

Ans. **(c)**

$$\rho = \frac{nA}{V_CN_A}$$

End of Solution

27. 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

Ans. **(b)**

By definition, the Burgers vector is perpendicular to an edge dislocation line. Also, the Burgers vector is invariant. the edge dislocation can glide only on a surface that contains both the Burgers vector and the t vector. These consideration are satisfied only when the given dislocation moves on a cylindrical surface containing the loop.

End of Solution

28. 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

Ans. **(c)**

Using principles of fracture mechanics, the critical stress (σ_C) required for crack propagation in a brittle material is

$$\sigma_c = \left(\frac{2E\gamma_s}{\pi a}\right)^{1/2}$$

where: E = Modulus of elasticity
γ_s = Specific surface energy
a = One half the length of an internal crack

End of Solution

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29. Ceramic material are

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

Ans. **(c)**

Ceramics are inorganic and non-metallic materials.

End of Solution

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30. 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

Ans. **(d)**

On the viscosity scale several specific points that are important in the fabrication and processing of glasses are labeled:

1. The melting point corresponds to the temperature at which the viscosity is 10 Pa-s (100 P): The glass is fluid enough to be considered a liquid.
2. The working point represents the temperature at which the viscosity is 10^3 Pa-s (10^4 P): the glass is easily deformed at this viscosity.

3. The softening point, the temperature at which the viscosity is 4×10^6 Pa-s (4×10^7 P), is the maximum temperature at which a glass piece may be handled without causing significant dimensional alternations.

End of Solution

31. 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)

Ans. **(c)**
Barium titanate ($BaTiO_3$) is commonly used piezoelectric ceramic.

End of Solution

32. 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

Ans. **(b)**
Fractography is the study of the fracture surfaces of the materials.

End of Solution

33. A transformer core is wound with a coil carrying an alternating current at a frequency of 50 Hz. 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) 200 W
(b) 250 W
(c) 300 W
(d) 350 W

Ans. **(c)**

$$P_{loss} = (60000) \times (10^{-4} \times 10^2) \times 50 \times 0.01 \text{ watt}$$
$$= 300 \text{ watt}$$

End of Solution

34. In a 440 V, 50 Hz 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) 1600 W
(b) 1400 W
(c) 1200 W
(d) 1000 W

Ans. **(a)**

As $\frac{V}{f}$ is constant

So, B_m is constant

$\therefore$ $P_e \propto B_m^2 f^2$

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$\therefore \quad P_e \propto f^2 \quad \text{or} \quad P_e = Af^2$ ...(i)

$\because \quad P_h \propto B_m^n f$

$\therefore \quad P_h = Bf$ ...(2)

Now, $A(50)^2 + B(50) = 2300$ ...(3)

$A(25)^2 + B(25) = 750$ ...(4)

or, $A(50) + B = \dfrac{2300}{50}$ ...(5)

$A(25) + B = \dfrac{750}{25}$ ...(6)

$25A = (46 - 30)$

$A = \dfrac{16}{25}$

$\therefore \quad P_e \text{ at } 440 \text{ V, } 50 \text{ Hz} = \left(\dfrac{16}{25}\right) \times (50)^2 = 1600 \text{ watt}$

End of Solution

35. 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

Ans. (b)

The repulsion of magnetic flux lines from the interior of superconducting material as the material undergoes transition to the superconducting state is known as **Meissner's effect**.

End of Solution

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

1. A substance loses 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

Ans. (b)

Even a small amount of impurity can reduce the transition temperature of superconductors; hence statement (3) is wrong.

End of Solution

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

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

Ans. **(d)**

End of Solution

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

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

Ans. **(d)**

Given, I_m = 1 mA, I_{ext} = 100 mA, R_m = 100 Ω

$$m = \frac{I_{ext}}{I_m} = \frac{100}{1} = 100$$

$$R_{sh} = \frac{R_m}{(m-1)} = \frac{100}{(100-1)} = 1.01\Omega$$

End of Solution

39. 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

Ans. **(d)**

End of Solution

40. 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

Ans. **(b)**

End of Solution

41. 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

Ans. **(a)**

$$\text{Error} = \delta A = A_m - A_T$$

Given error is negative, therefore $A_m < A_T \Rightarrow$ correction factor = +ve

$$A_T = A_m - \delta A$$

$$A_T = 95.45 - 0.08 = 95.37°C$$

End of Solution

42. Unit step response of first order system with transfer function

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

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

Ans. **(a)**

End of Solution

43. 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

Ans. **(d)**

End of Solution

44. 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

Ans. **(d)**

End of Solution

45. 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

Ans. (a)

End of Solution

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

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

Ans. (b)

$$R_t = R[1 + \alpha\,\Delta t]$$
$$= 100\left[1+\frac{0.00392}{°C}\times(65-25)°C\right]$$
$$= 100[1 + 0.00392 \times 40] = 115.68\ \Omega$$

End of Solution

47. 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

Ans. (d)

End of Solution

48. What are the advantages of capacitive transducers ?

1. They are extremely sensitive
2. They have a high input impedance and, therefore the loading 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

Ans. (d)

End of Solution

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49. 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 has 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

Ans. (c)

End of Solution

50. 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

Ans. (a)

End of Solution

51. The Laplace transform of a function $f(t)$ is $F(s) = \dfrac{s+2}{(s+2)^2+10^2}$

The value of $f(0)$ will be

(a) –1 (b) 0
(c) 1 (d) 2

Ans. (c)

$$F(s) = \frac{s+2}{(s+2)^2+10^2} = \frac{s+2}{s^2+4s+104}$$

$$\lim_{S\to\infty} SF(s) = \lim_{S\to\infty} \frac{s(s+2)}{s^2+4s+104} = \lim_{S\to\infty} \frac{s^2\left(1+\frac{2}{s}\right)}{s^2\left(1+\frac{1}{s}+\frac{104}{s^2}\right)} = 1$$

End of Solution

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

Its value by final value theorem in t domain will be

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

Ans. **(b)**

$$F(s) = \frac{2s+6-s}{s(s+3)} = \frac{s+6}{s(s+3)}$$

$$\lim_{s\to\infty} sF(s) = \frac{s(s+6)}{s(s+3)} = \frac{6}{3} = 2$$

End of Solution

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

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

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

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

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

Ans. **(a)**

$$Z_{11} = \left.\frac{V_1}{I_1}\right|_{I_2=0} = \frac{100}{10} = 10\ \Omega$$

$$Z_{21} = \left.\frac{V_2}{I_1}\right|_{I_2=0} = \frac{60}{10} = 6\ \Omega$$

$$Z_{22} = \left.\frac{V_2}{I_2}\right|_{I_1=0} = \frac{40}{3} = 13.33\ \Omega$$

$$Z_{12} = \left.\frac{V_1}{I_2}\right|_{I_1=0} = \frac{30}{3} = 10\ \Omega$$

End of Solution

54. 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) $\frac{1}{s(s-2)}$

Ans. **(a)**

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

End of Solution

55. For a two-port network, the 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) $z_{12} = z_{22}$

Ans. **(b)**

End of Solution

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

(a) $h_{12} = h_{21}$ (b) $h_{11} = h_{22}$

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

Ans. **(c)**

End of Solution

57. The initial current is $i(0^+)$, clockwise, and the circuit current being $i(t)$ and

$$v(t) = L \cdot \frac{di(t)}{dt}$$

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

Ans. **(a)**

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

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

$$V(s) = sLI(s) - Li(0^+)$$

End of Solution

58. In a series *R*-*L* circuit, *R* is 10 Ω and *L* is 20 mH, if the circuit current is 10 sin 314 *t* A, 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) $\tan^{-1}(0.8\pi)$

Ans. **(a)**

$$\theta = \tan^{-1}\frac{\omega L}{R}$$

$$= \tan^{-1}\frac{2\pi \times 50 \times 20 \times 10^{-3}}{10}$$

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

End of Solution

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

(a) $5 - j3.14$ (b) $5 + j3.14$

(c) $4 - j3.14$ (d) $4 + j3.14$

Ans. **(d)**

$$Z = R + jX_L = R + j\omega L$$
$$= 4 + j(2\pi \times 50 \times 10 \times 10^{-3})$$
$$= 4 + j3.14$$

End of Solution

60. A 100 V, 50 Hz a.c. supply is applied across a series *RLC* circuit having R =10 Ω, L =100 mH and C = 1000 μF. 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

Ans. **(b)**

$$I = \frac{V}{Z}$$

$$Z = 10 + j\left[2\pi \times 50 \times 100 \times 10^{-3} - \frac{1}{314 \times 1000 \times 10^{-6}}\right]$$

$$= 10 + j[31.4 - 3.184]$$
$$= 10 + j28.2\ \Omega$$

$$I = \frac{100}{10 + j28.2} = 3.33 \angle -70.5°\ \text{A}$$

End of Solution

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

(a) 0.482 (b) 1.000

(c) 0.055 (d) 0.500

Ans. **(c)**

End of Solution

62. If T_A = 50°C, T_J = 200°C and θ_{J-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

Ans. **(b)**

$$\theta = \frac{T_j - T_A}{P_D}$$

$$\Rightarrow \quad P_D = \frac{T_j - T_A}{\theta} = \frac{150}{100}$$

$$P_D = 1.5\ \text{W}$$

End of Solution

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63. In a differential amplifier, there are two sets of input signals. In first set, $\nu_1 = +50\ \mu V$ and $\nu_2 = -50\ \mu V$ and in second set, $\nu_1 = 1050\ \mu V$ and $\nu_2 = 950\ \mu V$. 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%

Ans. **(a)**

$$V_o = A_{DM} V_d + A_{CM} V_{CM}$$

$$V_{o_1} = A_{DM} V_d + 0$$

$$V_{o_2} = A_{DM} V_d + A_{CM} V_{CM}$$

$$\% \text{ Difference} = \frac{V_{o_2} - V_{o_1}}{V_{o_1}} \times 100\% = \frac{A_{CM} V_{CM}}{A_{DM} V_d} \times 100\%$$

$$= \frac{1}{100} \times \frac{1000\,\mu V}{100\,\mu V} \times 100\% = 10\%$$

End of Solution

64. A linear ramp *ADC* uses a 10 bit counting register and a 15 kHz clock frequency. The register output is 1111111111 when the input voltage is 100 mV. 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 ins (d) 2.5 V/s and 75 ms

Ans. **(a)**

End of Solution

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

(a) 12.8 V (b) 17.8 V

(c) 22.8 V (d) 27.8 V

Ans. **(a)**

Number of bits in DAC = $n = \delta$

$\because$ $V_{out} = 0.05$ V for input of 00000001, it can be concluded that resolution, of the DAC, $R = 0.05$ volts.

Now, in general, $R = \frac{V_{FS}}{2^n - 1}$, where V_{FS} is the full scale output

Hence, $0.05 = \frac{V_{FS}}{2^8 - 1}$

$\Rightarrow$ $V_{FS} = 0.05 \times 255 = 12.75\ V \simeq 12.8\ V$

End of Solution

66. Master-Slave flip-flop is also called

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

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

Ans. **(a)**

End of Solution

67. The resolution of 6-bit *DAC* will be nearly

(a) 4.6% (b) 3.2%

(c) 1.6% (d) 1.2%

Ans. **(c)**

The percent resolution of a *n*-bit DAC is given by

$$\% \text{ resolution} = \frac{1}{2^n - 1} \times 100\%$$

Hence, the percent resolution of a 6-bit DAC will be given by

$$= \frac{1}{2^6 - 1} \times 100\% = \frac{1}{63} \times 100\%$$
$$= 1.587\% = 1.67\%$$

End of Solution

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

(a) A (b) B

(c) 0 (d) 1

Ans. **(c)**

The following two standard theorems of Boolean algebra can be used to simplify the given boolean expression:

(a) De Morgan's theorem theorem:

$$\overline{A + B + C} = \bar{A} \cdot \bar{B} \cdot \bar{C}$$

(b) Involution theorem

$$\bar{\bar{A}} = A$$

Now, given expression is

$$f = \overline{\overline{AB} + \bar{A} + AB} = \bar{\bar{A}\bar{B}} \cdot \bar{\bar{A}} \cdot \overline{AB}$$
$$= AB \cdot A \cdot \overline{AB} = AB \cdot (\bar{A} + \bar{B})$$
$$= AB \cdot \bar{A} + AB \cdot \bar{B}$$
$$= 0 + 0 = 0$$

x

End of Solution

69. *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

Ans. **(c)**
Before implementing a Boolean function in the form of a digital circuit, it is simplified. To simplify Boolean functions of 3, 4, 5, 6 variables, we use *K*-map. For larger number of variables, we generally use the tabulation method like the Quine Mc Cluskey algorithm.

End of Solution

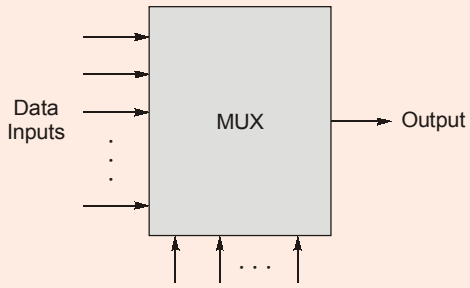
70. A finite state machine
(a) is same as that of abstract model of sequential circuit
(b) consists of combinational logic circuits only
(c) contains infinite number of memory devices
(d) does not exist in practice

Ans. **(a)**

End of Solution

71. 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

Ans. **(a)**
A multiplexer is combinational circuit that has multiple data inputs and a single output. At any instant, any one of the multiple data inputs gets through the output of the circuit.

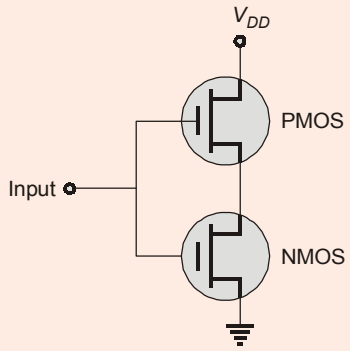


End of Solution

72. The memory technology which needs the least power is
(a) ECL
(b) MOS
(c) CMOS
(d) TTL

Ans. **(c)**

A CMOS consists of NMOS and PMOS. At any instant, only one of the two transistors are on. As a result of this, negligible current conduction takes place in CMOS, and hence, its power dissipation is very low.



End of Solution

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

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

Ans. **(b)**

End of Solution

74. A device has 200 Ω equivalent noise resistance, 300 Ω 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

Ans. **(a)**

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

$$K = 1.38 \times 10^{-23} \frac{\text{Joules}}{\text{Kelvin}}$$

$$T = 290K$$

$$B = 6 \text{ MHz}$$

$$R = 200 + 300 = 500\ \Omega$$

$$V_n = 7\ \mu V$$

End of Solution

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

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

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Ans. **(a)**

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

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

$$\mu \simeq 0.99$$

End of Solution

76. Frequency modulated signal with single-tone modulation-has a frequency deviation of 15 kHz 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

Ans. **(b)**

$$BW = 2[\Delta f + f_m]$$
$$50\ k = 2[15k + f_m]$$
$$f_m = 10\ \text{kHz}$$

End of Solution

77. 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%

Ans. **(c)**

$$\%\ \text{of power saving} = \frac{4+\mu^2}{4+2\mu^2}$$

$$\mu = 0.5$$

$$\%\ \text{Power saving} = 94.5\%$$

End of Solution

78. 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

Ans. **(d)**

End of Solution

79. 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

Ans. **(b)**

$(Q_c)_{max} \le 11 \times V_{p-p}$

$\therefore$ Dynamic range $= V_{p-p}$

$$\frac{1}{L} \le \frac{1}{50}$$

$$L \ge 50$$

$$L_{min} = 50$$

End of Solution

80. 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

Ans. **(d)**

$$(SQNR)_{dB} \ge 40 \text{ dB}$$

$$1.8 + 6n \ge 40$$

$$n \ge 6.36$$

$$n_{min} = 7$$

$$L_{min} = 128$$

End of Solution

81. 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) $A \le \dfrac{2\pi f_m}{\Delta f_s}$ (d) $A \le \dfrac{\Delta f_s}{2\pi f_m}$

Ans. **(d)**

To overcome slope over load error $\Rightarrow \dfrac{\Delta}{T_s} \ge 2\pi f_m A_m$

$$A_m \le \frac{\Delta}{T_s \times 2\pi f_m}$$

$$A_m \le \frac{\Delta f_s}{2\pi f_m}$$

End of Solution

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

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

Ans. **(d)**

End of Solution

83. 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

Ans. **(d)**

End of Solution

84. 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

Ans. **(c)**

End of Solution

85. An inductor is described by input-output relation as

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

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) $Ly(t)$

Ans. **(a)**

End of Solution

86. 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

Ans. **(d)**

$$\text{Step response} = \int_{0}^{t} (\text{Impulse response})\cdot dt$$

End of Solution

87. 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

Ans. **(c)**
SFG is graphical representation mathematical relation between variables of a system in the form of set of linear algebraic equation in cause-effect form.

End of Solution

88. If all the roots of the characteristic equation have negative real parts, the system is
(a) Stable (b) Unstable
(c) Marginally stable (d) Conditionally stable

Ans. **(a)**
For a stable system all closed loop poles (CLP) must be in left side of *s*-plane.

End of Solution

89. 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

Ans. **(b)**
For a type-1 system, steady state error for
(i) Step input = 0
(ii) Ram input = $\frac{1}{K_v} = \frac{1}{1} = 1$

End of Solution

90. 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 seconds, 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

Ans. **(b)**

End of Solution

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91. If any root of the characteristic equation has a positive real part or if there is a repeated root on the $j\omega$-axis, then the system is

(a) Limitedly stable
(b) Conditionally stable
(c) Stable
(d) Unstable

Ans. **(d)**

If any closed loop poles (CLP) is in right side of s-plane (or) if multiple CLP lies on $j\omega$-axis then the system is unstable.

End of Solution

92. 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°

Ans. **(d)**

End of Solution

93. 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

Ans. **(d)**

Feedback in control system is used to control sensitivity, effect of disturbance and non linearities.

End of Solution

94. 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) $\frac{2\omega_d}{\pi}$

Ans. **(b)**

$$t_p = \frac{n\pi}{\omega_d}$$

For first undershoot $n = 2$.

End of Solution

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

(a) Lag (b) Lead

(c) Lag-lead (d) Zero

Ans. **(a)**

Lag compensator is analogous to PI controller, improves steady state response.

End of Solution

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

(a) Proportional (b) Integral

(c) Derivative (d) PID

Ans. **(b)**

Integral controller is also called reset controller.

End of Solution

97. 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

Ans. **(d)**

Since time for "r" revolutions is 1 sec. So, time for 1 revolution will be $\frac{1}{r}$ sec.

Since "N" bytes are transferred in one rotation so "b" bytes will be transferred in

$$= \frac{b}{rN}$$

End of Solution

98. 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

Ans. **(b)**

End of Solution

99. 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) 2 and 3 only
(c) 3 and 4 only (d) 1 and 4 only

Ans. **(a)**

I/O and power failure are related to external interrupts like DMA and TRAP.

End of Solution

100. In an assembly language program END is a/an

(a) Machine instruction (b) Pseudo instruction
(c) Micro instruction (d) Interrupt

Ans. **(b)**

END is an assembler directive/pseudo instruction.

End of Solution

101. Booth algorithm is associated with

(a) Binary division (b) Binary integer multiplication
(c) Sorting binary integers (d) Searching of binary data

Ans. **(b)**

End of Solution

102. The memory that communicates directly with CPU is called

(a) Auxiliary memory (b) USB storage
(c) Main memory (d) Micro-program memory

Ans. **(c)**

End of Solution

103. Virtual memory is normally implemented by

(a) Demand paging (b) Buses
(c) Device drivers (d) Bus matrix

Ans. **(a)**

End of Solution

104. 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

Ans. **(d)**

From a user's point of view, the two most important characteristics of memory are capacity and performance. Three performance parameters are used:

Access time (latency): For random-access memory, this is the time it takes to perform a read or write operation, that is, the time from the instant that an address is presented to the memory to the instant that data have been stored or made available for use. For non-random-access memory, access time is the time it takes to position the read-write mechanism at the desired location.

Memory cycle time: This concept is primarily applied to random-access-memory and consists of the access time pulse any additional time may be required for transients to die out on signal lines or to regenerate data if they are read destructively. Note that memory cycle time is concerned with the system bus, not the processor.

Transfer rate: This is the rate at which data can be transferred into or out of a memory unit. For random-access memory, it is equal to 1/(cycle time).

End of Solution

105. 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 unauthorised 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

Ans. **(b)**

End of Solution

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

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

Ans. **(b)**

End of Solution

107. 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 be obtained
(d) The lock transactions are best suited with a lot of activity

Ans. **(a)**

End of Solution

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108. 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

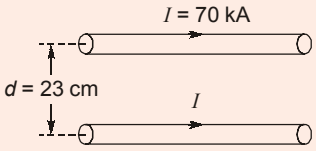
Ans. **(b)**

End of Solution

109. 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) 4,400 N/m (d) 4,260 N/m

Ans. **(d)**



Force between two parallel conductor

$$F = \frac{\mu_o I_1 I_2}{2\pi d} h \text{ (Newton)}$$

$$\frac{f}{h} = \frac{4\pi \times 10^{-7}(70\times 70)(10^6)}{2\pi(23\times 10^{-2})}$$

$$= \frac{2(490)(100)}{23} = 4260.86 \text{ (N/m)}$$

End of Solution

110. 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

Ans. **(a)**

$M(2, 5, -3)$ and $N(-3, 1, 4)$

$$\text{Mid-point of } MN = \left(\frac{2-3}{2}, \frac{5+1}{2}, \frac{-3+4}{2}\right) = \left(\frac{-1}{2}, 3, \frac{1}{2}\right)$$

Distance from the origin to mid-point of MN is

$$= \sqrt{\left(0-\frac{1}{2}\right)^2 + (0-3)^2 + \left(0-\frac{1}{2}\right)^2} = \sqrt{\frac{1}{4}+9+\frac{1}{4}} = \sqrt{9.5} = 3.08 \simeq 3.1$$

End of Solution

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

(a) –8 μC/m^3 (b) –6 μC/m^3

(c) –4 μC/m^3 (d) –2 μC/m^3

Ans. (b)

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

Given, $\rho_v = 0$ and satisfies Maxwell equation

$$\vec{\nabla} \cdot \vec{D} = 0$$

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

$$\frac{\partial}{\partial x}(10x) + \frac{\partial}{\partial y}(-4y) + \frac{\partial}{\partial z}(kz) = 0$$

$$10 - 4 + k = 0$$

$$\Rightarrow \quad k = -6\ \frac{\mu C}{m^3}$$

End of Solution

112. 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

Ans. (c)

Total conductors = 45 × 18

N = 1200 rpm

Flux per pole = ϕ = 0.016 Wb, A = 2

P = 4

$$E_g = \frac{\varphi PN}{60} \times \frac{Z}{A} = \frac{0.016 \times 4 \times 1200}{60} \times \frac{45 \times 18}{2}\ V = 518.4\ V$$

End of Solution

113. 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 = Characteristics impedance of line, Ω

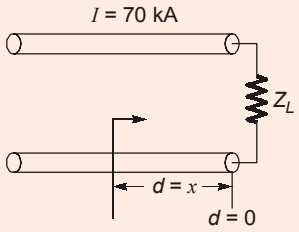
Z_L = Load impedance, Ω

γ = Propagation constant = $\alpha + j\beta$, m^{-1}

α = Attenuation constant, Np m^{-1}

β = Phase constant, rad m^{-1}

Ans. **(a)**



$$Z(d = x) = Z_0 \frac{Z_L + Z_0 \tanh\gamma x}{Z_0 + Z_L \tanh\gamma x}\ \Omega$$

End of Solution

114. 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

Ans. **(b)**

For a good conductor

$$\text{Depth of penetration} = \delta = \frac{1}{\alpha} = \frac{1}{\sqrt{\pi f \mu\sigma}}$$

End of Solution

115. A rectangular waveguide is 5.1 cm by 2.4 cm (inside measurements). 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

Ans. **(d)**

In rectangular waveguide a = 5.1 cm : b = 2.4 cm

Find $f_{c_{10}}$:

$$f_{c_{10}} = \frac{c}{2a} = \frac{3\times10^8}{2(5.1\times10^{-2})} = \frac{3}{2(5.1)}\times10^{10}$$

$$= 2.94 \text{ GHz}$$

End of Solution

116. 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) $44\left(\frac{r}{\lambda}\right)^2$

Ans. (b)

$$G = \pi^2\left(\frac{D}{\lambda}\right)^2 K$$

$D = 2r$ = Diameter

K is aperture efficiency.

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

$$G = \pi^2\left(\frac{D}{\lambda}\right)^2 K = \pi^2\left(\frac{2r}{\lambda}\right)^2 (0.7)$$

$$= 27.63\left(\frac{r}{\lambda}\right)^2$$

End of Solution

117. 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

Ans. (a)

Antenna radiates isotropically over a half space ($2\pi r^2$).

Given, $E_{rms} = 50\times10^{-3}\left(\frac{V}{m}\right)$ at r = 1 km

Antenna terminal current = I_{rms} = 3.5 A

$$P_{rad} = I_{rms}^2 R_{rad} \quad ...(i)$$

$$P_{rad} = \left|\vec{P}_{avg}\right| (\text{area})$$

$$P_{rad} = \frac{E_{rms}^2}{\eta_0}(2\pi r^2) \quad ...(ii)$$

$$R_{rad} = \frac{P_{rad}}{I_{rms}^2} \quad ...(iii)$$

By equations (ii) and (iii)

$$R_{rad} = \frac{E_{rms}^2(2\pi r^2)}{\eta_0 I_{rms}^2}$$

$$= \frac{(50\times10^{-3})^2 2\pi\times(10^3)^2}{120\pi\,(3.5)^2} = \frac{50\times50}{60(3.5)^2} = 3.401\,\Omega$$

End of Solution

118. 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

Ans. (a)

$$A_e = \frac{\lambda^2}{4\pi} G_d$$

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

End of Solution

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

(a) $\frac{\lambda^2}{16\pi^2 r^2 k T_{sys} B}$ (b) $\frac{\lambda^2}{14\pi^2 r^3 k T_{sys} B}$

(c) $\frac{\lambda^2}{12\pi^2 r^4 k T_{sys} B}$ (d) $\frac{\lambda^2}{10\pi^2 r^4 k T_{sys} B}$

where: λ = Wavelength, m
r = Distance from transmitter to receiver, m
T_{sys} = System temperature, K
B = Bandwidth, Hz
k = Boltzmann's constant

Ans. (a)

$$\text{SNR} = \frac{\lambda^2}{16\pi^2 r^2 k T_{sys} B}$$

End of Solution

120. Consider a cube defined by

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

If vector, $\vec{A} = 2x^2y\hat{a}_x + 3x^2y^2\hat{a}_{y,}$

$\nabla \cdot \vec{A}$ at the centre of the cube will be

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

Ans. **(b)**

$$A = 2x^2y\bar{i} + 3x^2y^2\bar{j}$$

$$\nabla \cdot \vec{A} = \frac{\partial}{\partial x}(2x^2y) + \frac{\partial}{\partial y}(3x^2y^2)$$

$$= 4xy + 6x^2y$$

when $(x, y, z) \in [1, 3]$

$$1 \le x \le 3$$
$$1 \le y \le 3$$
$$1 \le z \le 3$$

$\therefore$ Mid-point of the cube is [2, 2, 2]

$\therefore$ $\nabla \cdot \vec{A}_{(2,2,2)} = 4(2)\ (2) + 6(2)^2\ (2) = 16 + 48 = 64$

End of Solution

121. 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

Ans. **(d)**

End of Solution

122. 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

Ans. **(c)**

End of Solution

123. 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

Ans. **(b)**

End of Solution

124. 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

Ans. **(a)**

h-parameters, $V_1 = h_{11} I_1 + h_{12} V_2$
$I_2 = h_{21} I_1 + h_{22} V_2$

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

End of Solution

125. 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

Ans. **(a)**

$$Z_{11} = \left.\frac{V_1}{I_1}\right|_{I_2 = 0}$$

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

$$Z_{21} = \left.\frac{V_2}{I_1}\right|_{I_2 = 0} = \frac{25}{20} = 1.25\ \Omega$$

$$Z_{22} = \frac{100}{10} = 10\ \Omega$$

$$Z_{12} = \left.\frac{V_1}{I_2}\right|_{I_1=0} = \frac{50}{10} = 5\,\Omega$$

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

End of Solution

126. 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_o and the normalized angular 3-dB bandwidth $\Delta\omega_{3\text{ dB}}$ 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

Ans. **(a)**

$$\omega = \Omega \cdot T_s = \frac{\Omega}{f_s} = \frac{2\pi 60}{400} = 0.3\pi$$

$$\text{Bandwidth} = \frac{0.3\pi}{10} = 0.03\pi$$

End of Solution

127. 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

Ans. **(d)**

End of Solution

128. 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

Ans. **(a)**

End of Solution

129. 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) $M - 1$

Ans. (a)

End of Solution

130. 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

Ans. (c)

End of Solution

131. 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

Ans. (a)
In internal RAM stack allows only direct addressing mode.
They don't occupy any memory space but resemble as instruction.

End of Solution

132. PUSH and POP operations are performed by
(a) Program counter register
(b) General purpose register
(c) Stack pointer register
(d) Link register

Ans. (c)
PUSH and POP are used w.r.t. stack memory and the relevant register is stack pointer.

End of Solution

133. Network Interface Card (NIC) has a unique six-byte permanent address as
(a) IP address
(b) MAC address
(c) DNS address
(d) Local address

Ans. (b)

End of Solution

134. 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

Ans. **(b)**

DLL provides flow control and error control through retransmission and CRC.

End of Solution

135. 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

Ans. **(b)**

End of Solution

136. 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)

Ans. **(c)**

End of Solution

137. 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 (LCQ
(b) Lost Calls Delayed (LCD)
(c) Lost Calls Held (LCH)
(d) Lost Calls Hand off

Ans. **(b)**

End of Solution

138. 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

Ans. **(a)**

End of Solution

139. 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 $\frac{C}{N} = 8.8$ 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

Ans. **(c)**

$$\frac{E_b}{N_o} = \frac{C \times T_b}{N/B} = \frac{C \times B}{N \times R_b}$$

C = Carrier power

$\because$ $N = N_o B$

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

$\because$ For sinc (or) Nyquist pulses

BW of BPSK = R_b

$$\frac{E_b}{N_o} = \frac{C \times R_b}{N \times R_b}$$

$$\frac{E_b}{N_o} = \frac{C}{N}$$

$$\frac{E_b}{N_o} = 8.8 \text{ dB}$$

End of Solution

140. For a total transmit power (P_t) of 1000 W 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

Ans. **(b)**

$$E_b = P \times T_b = \frac{P}{R_b} = \frac{1000}{50 \times 10^6} = 20\,\mu J$$

End of Solution

141. 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

Ans. **(d)**

End of Solution

142. 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

Ans. **(b)**

End of Solution

143. 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

Ans. **(d)**

$$BW \times L = 600 \text{ MHz-km}$$
$$L = 0.3 \text{ km}$$
$$BW = \frac{600 \text{ MHz-km}}{0.3 \text{ km}} = 2 \text{ GHz}$$

End of Solution

144. 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

Ans. **(b)**

End of Solution

Directions: Each of the next **Six (6)** items consist 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 code given below:

Code:
(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)
(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is **NOT** the correct explanation of Statement (I)
(c) Statement (I) is true but Statement (II) is false
(d) Statement (I) is false but Statement (II) is true

145. **Statement (I):** 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.

Ans. **(c)**

A vocoder is an audio compressor that captures the characteristic elements of an audio signal and then using this characteristic signal to affect the other audio signal. The effect is called as vocoding and corresponding device is called as "talking vocoder".
Voice speech is produced by taking impulse train as excitation. For unvoiced signal, a random white noise is used as the excitation.
Statement I is true and statement II is false.

End of Solution

146. **Statement (I):** Control logic in CMOS is constructed using two-level SOP logic and multi-level logic.
Statement (II): Typical PLA uses multi-level logic.

Ans. (c)

End of Solution

147. **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.

Ans. (b)

End of Solution

148. **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).

Ans. (b)

End of Solution

149. **Statement (I):** PCM requires a very complex encoding and quantization circuitry.
Statement (II): PCM requires a less bandwidth compared to analog systems.

Ans. (c)
Compared to DM, PCM is complex and compared to analog systems, PCM requires high bandwidth.
So, statement I is true and statement II is false.

End of Solution

150. **Statement (I):** For an unstable feedback 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.

Ans. (d)
For unstable system both GM and PM are negative and for stable system both GM and PM are positive.

End of Solution