Mock Test 4

Number of Questions: 65 **Total Marks: 100**

Wrong answer for MCQ will result in negative marks, (-1/3) for 1 Mark Questions and (-2/3) for 2 Marks Question.

GENERAL APTITUDE

Directions for question 1: Choose the most appropriate word from the options given below to complete the following sentence.

1. Despite its known toxicity, lead continues to be used, to the great _____ of human and environmental health.

(A) impediment (B) detriment
(C) chagrin (D) solace

Directions for questions 2 and 3: Select the correct alternative form the given choices.

2. A 7-year old child assembles an object from lego blocks. The object is in the shape of a cylinder surmounted by a hemisphere of radius 7 cm. If the height of the cylinder is 7 cm, find the volume of the object (in cm^3).

(A) $\frac{3\pi}{5}(7^2)$ (B) $\frac{5\pi}{3}(7^3)$
(C) 7^3 (D) $7^3\pi$

3. In a certain code language, if Zoology is called Anthropology, Anthropology is called Ornithology, Ornithology is called Biology, Biology is called Cosmology, Cosmology is called Ecology, Ecology is called Etymology, then what is the study of human called in that language?

(A) Biology (B) Ecology
(C) Ornithology (D) Cosmology

Directions for question 4: Select the pair that best expresses a relationship similar to that expressed in the capitalized pair.

4. BIOLOGY : LIFE

(A) Archaeology: Antiques
(B) Astrology: Stars
(C) Cosmetology: Beauty
(D) Mythology : Myths

Directions for question 5: Fill in the blanks from the options given below:

5. _____ summer monsoon _____ been showing a weakening trend _____ the past century with decreasing rainfall over large regions of _____ Indian subcontinent.

(A) The, has, over, the
(B) The, has, over, no article
(C) A, had, across, no article
(D) The, has, in, the

Directions for questions 6 to 10: Select the correct alternative form the given choices.

6. a, b, c, d are distinct positive integers such that:
$f(a, b, c, d) = \max(a, b, c, d)$
$g(a, b, c, d) = \min(a, b, c, d)$
$h(a, b, c, d)$ = remainder of $(c \times d / a \times b)$
If $(c \times d) > (a \times b)$
$h(a, b, c, d)$ = remainder of $(a \times b) / (c \times d)$ if $(c \times d) < (a \times b)$
Also, a function fgh $(a, b, c, d) = f(a, b, c, d) \times g(a, b, c, d) \times h(a, b, c, d)$ the value of $fg[h(12, 11, 8, 16), 17, 9, 16]$ _____

7. Textbooks of medicine say that there is no direct connection between the brain and the lymphatic system, yet a paper published in the journal *Nature* refers to the discovery of exactly such a connection.
Which one of the statements given below is logically valid and can be inferred from the above sentence.

(A) A paper published in the journal *Nature* corroborates the fact that there is no direct connection between the brain and the lymphatic system.
(B) Textbooks of medicine declare that there is no direct connection between the brain and the lymphatic system and this is affirmed by a paper published in the journal *Nature*.
(C) Texts of medicine proclaim that there is no direct connection between the brain and the lymphatic system but a paper published in the journal *Nature* says that such a connection is indeed there.
(D) While textbooks of medicine maintain that there is no direct connection between the brain and the lymphatic system, a paper published in the journal *Nature* claims that the brain and the lymphatic system are connected indirectly.

8. The last decade has witnessed a slow but steady realisation within the Indian government that the threats of the future will come from cyberspace. Unfortunately, while the realisation exists, the Indian security establishment has not been jolted into action in the manner in which the Kargil War or the 26/11 terrorist attack on Mumbai galvanised the nation into adopting a series of corrective measures.
Which of the statement(s) below is/are logically valid and can be inferred from the above passage?

(i) Although the Indian government realizes that the threats of the future will be from cyberspace, it is yet to accord the seriousness which is due to this threat.
(ii) Despite the fact that the Indian government realizes that the future threats will come from

cyberspace, it does not consider these threats as devious as other threats which spurred the government to adopt corrective measures.

(iii) The Indian government considers that the threats from cyberspace will not pose a serious threat to the security of the nation.

(iv) The Indian government fails to consider that the threats from cyberspace could pose a threat to the security of a nation.

(A) Only (i) (B) (i) and (ii)
(C) (iii) and (iv) (D) (i), (ii) and (iii)

9. 30 students in class of BV School, wrote a test with 4 questions. For each question the number of students who answered correctly, incorrectly and did not attempt are tabulated below. The marks for each question are also listed in the table. There is no negative marking or partial marking.

Q.No.	Marks	Answered correctly	Answered incorrectly	Did not attempt
1	3	15	5	10
2	2	10	7	13
3	2	20	9	1
4	1	11	10	9

If the number of students who attempted all questions is 5, what is the maximum possible number of students who left at least 2 questions unattempted?

(A) 3 (B) 16
(C) 8 (D) None of these

10. The given statement is followed by some courses of action. Assuming the statement to be true, decide which of the given courses of action logically follows for pursuing.

Statement:

There have been steep increases in the government's expenditures on garbage collection, sorting, storage and recycling.

Courses of action:

(i) Government should encourage people to sort their garbage, by providing them separate bins for dry and wet garbage.

(ii) Once garbage is collected from households, to the extent possible it should be directed towards recycling, so that it can cut down on storage costs.

(iii) The routes of the collection vehicles should be planned in such a way that they are used in a most efficient manner.

(A) Only (i) and (ii) follow
(B) Only (ii) and (iii) follow
(C) Only (i) and (iii) follow
(D) All (i), (ii) and (iii) follow

ELECTRONICS AND COMMUNICATION ENGINEERING

Direction for questions 1 to 55: Select the correct alternative form the given choices

11. A letter is selected at random from each of the two words 'FRACTION' and 'DECIMAL'. Probability that the selected letter in a word should NOT be in the other word is _____

(A) 3/14 (B) 5/14
(C) 7/13 (D) 9/13

12. The value of $\lim_{x\to 3} \log_5\left[4x^3+\sqrt{3x^4+5x^2+1}\right]$ is _____

13. The absolute error in the process of finding the real root of $x^3 + x^2 + 4x + 4 = 0$ by Newton-Raphson method with initial approximation $x_o = 2$ after one iteration is _____.

14. If **V** is an n-dimensional vector space, then which of the following statements is NOT TRUE?

(A) Every subset of n linearly independent vectors of **V** is a basis of **V**.

(B) Every subset of n vectors of **V** that spans **V** is a basis of **V**.

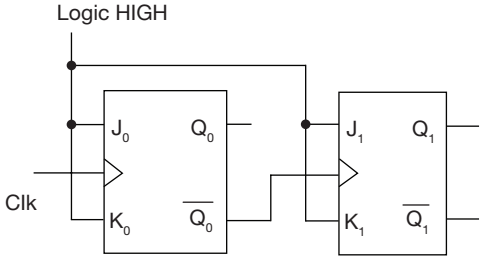
(C) If $v_1, v_2, v_3, \ldots\ldots, v_K$, $K <$ n are linearly independent vectors in **V**, then there exists elements $v_{K+1}, v_{K+2}, \ldots\ldots. v_n$ in **V** such that $\{v_1, v_2, v_3, \ldots\ldots. v_n\}$ is a basis of **V**.

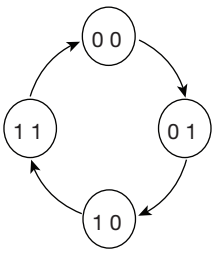
(D) None of these

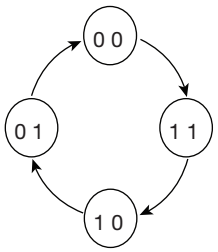
15. If $\overline{F}$ and $\overline{G}$ are any two vectors with magnitudes f and g respectively, then $\left|\left(\overline{F}-\overline{G}\right)\times\left(\overline{F}+\overline{G}\right)\right|^2$ is equal to _____

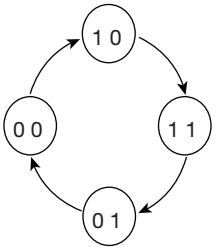
(A) $4f^2g^2$ (B) $4\left(\overline{F}.\overline{G}\right)^2$
(C) $4\left[f^2g^2-\left(\overline{F}.\overline{G}\right)^2\right]$ (D) $4\left[f^2g^2+\left(\overline{F}.\overline{G}\right)^2\right]$

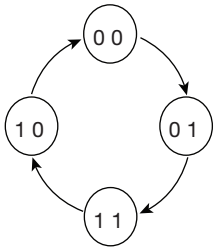
16. For the counter shown in figure, find the state diagram for the states $Q_1\,Q_0$?



(A)


(B)


(C)


(D)


17. Sensors are used to monitor the pressure and the temperature of a chemical solution stored in a boiler. The circuitry for each sensor produces a HIGH voltage (Logic 1) when a specified maximum value is exceeded. An alarm requiring a Low voltage (Logic 0) input must be activated when either the pressure or the temperature is excessive. The circuit for this application uses _____ gate.

(A) NAND (B) NOR
(C) AND (D) XOR

18. Consider a five bit digital to analog converter, the analog value corresponding to digital signals of values 00000 and 01000 are 0V and 1.2V respectively. The full scale reading of the *D* to *A* converter is _____ (in volts).

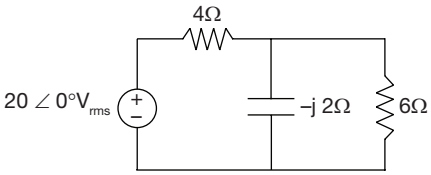
19. In a rectangular waveguide 2.5 cm × 1.8 cm carries a dominant mode of a signal at 8 GHz frequency then find characteristic impedance of transverse electric field.

(A) 570 Ω (B) 250 Ω
(C) 470.3 Ω (D) 382.9 Ω

20. In a lossless dielectric media magnetic field component is given as $\overline{H} = 10\cos(10^8 t - x)\hat{a}_z$ mA/m, then wave is said to be polarized along

(A) *x*-axis (B) *y*-axis
(C) *z*-axis (D) *x*-*z* plane

21. Consider the circuit show in below figure

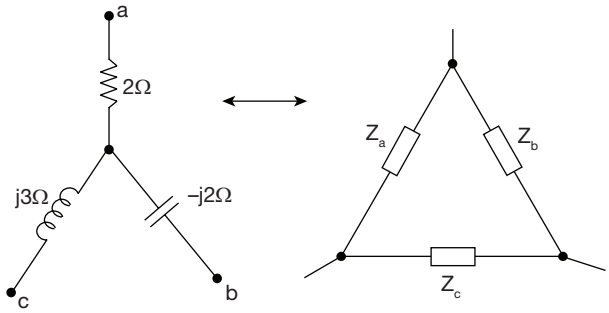


The average power delivered by the source is_____.

(A) 37.85W, *pf* = 0.93 (Leading)
(B) 75.7W, *pf* = 0.93 (Leading)
(C) 75.W, *pf* = 0.93 (Lagging)
(D) 37.85 W, *pf* = 0.93 (Lagging)

22. A series RLC circuit consists of a 40Ω resistance, 0.3H Inductance and 8μF capacitance with an applied voltage of 15V. Then the upper cut off frequency is _____ Hz.

23. Consider the networks shown in below figure



The ratio between the $|Z_a|$ and $|Z_c|$ is _____.

24. A transistor is connected in common emitter configuration as an amplifier. The parameters of the transistor specified are: I_B = 20 μA, β = 100 and I_C = 2.5 mA. Then the value of I_{CEO} is ____mA.

25. An *n*-channel JFET having a pinch-off voltage of –4V shows a trans conductance of 1.5 mA/V. If its maximum trans conductance is 2 mA/V, then the applied Gate to source voltage in volts _____.

26. Find the value of gain for which the closed loop transfer function will have a pole on the real axis at –4.

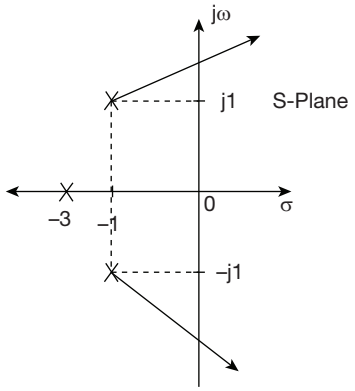
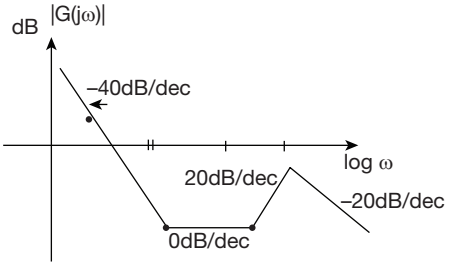


Figure: Root locus plot

(A) $K = 8$ (B) $K = 10$
(C) $K = 5$ (D) $K = 2$

27. The asymptotic Bode magnitude plot of a minimum phase transfer function is shown in the figure.

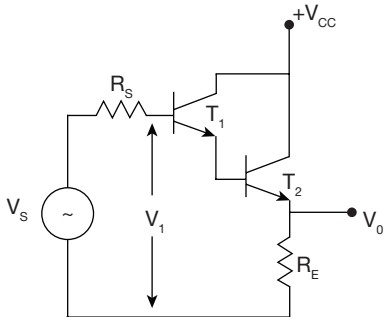


This transfer function has
(A) 3 poles and 2 zeros (B) 4 poles and 3 zeros
(C) 4 poles and 2 zeros (D) 3 poles and 1 zeros.

28. Let $X(z) = \frac{1}{1-z^{-3}}$ be the z – transform of a Non-causal signal $x[n]$, then the values of $x[-1]$ and $x[-3]$ is
(A) 0 and 0 (B) 0 and 1
(C) 1 and 0 (D) 1 and 1

29. Two signals $x_1(t)$ and $x_2(t)$ are given as
$x_1(t) = 8\ \text{sinc}^2(200t)\ \cos(800\pi t)$
$x_2(t) = 10\ \text{sinc}(200t)$
if the Nyquist sampling rate N_1 and N_2 respectively, the ratio N_1/N_2 is _____.

30. Common mode configuration of stage 1, stage 2 in the given circuit shown in fig are _____ respectively.



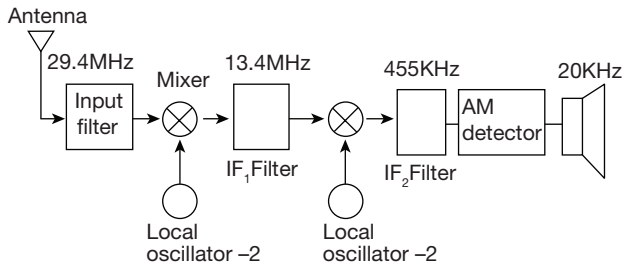
(A) *CE* – *CE* (B) *CE* – *CB*
(C) *CC* – *CC* (D) *CE* – *CC*

31. Highest Operating cycle in the following power amplifier
(A) Class *A* (B) Class *B*
(C) Class *C* (D) Class *AB*

32. The series-shunt feedback amplifier having $A = -10$ and $\beta = -0.1$. If $\frac{Z_0}{Z_i} = 5$. Then the ratio of input impedance to output impedance of the feedback amplifier is _____.

33. A signal having a bandwidth of 2.4MHz is transmitted using binary PCM system and the number of quantization levels are 512. The final bit rate (in Mbps) is _____.

34.



Frequency of local oscillator – 1 and local oscillator – 2 are respectively.
(A) 41.89MHz & 12.945MHz
(B) 42.8MHz & 13.855MHz
(C) 13.855MHz & 42.8MHz
(D) None of these

35. The PDF of a random variable X is $P(x)$ A random variable Y is defined as _____
$Y = aX + b$
Where $x < 0$. Determine the PDF of Y in terms of the PDF of X.
(A) $\frac{1}{a} f_x\left(\frac{y-b}{a}\right)$ (B) $f_x\left(\frac{y-b}{a}\right)$
(C) $af_x\left(\frac{y-b}{a}\right)$ (D) None of these

36. The maximum volume of a cylindrical cistern with open top of surface area (Area of bottom and side) 108π square feet is _____
(A) 216 π cubic feet (B) 432 π cubic feet
(C) 864 cubic feet (D) 1728 cubic feet

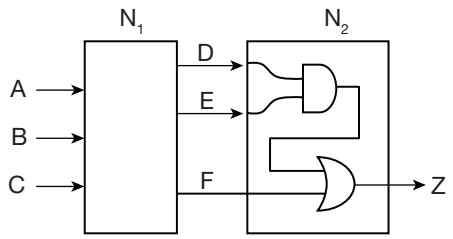
37. If the eigen values of a 3 × 3 matrix A are –1, 2 and 5 then the determinant of the inverse of the matrix $A + 2I_3$, where I_3 is the identity matrix of order 3 × 3 is _____
(A) $\frac{-1}{10}$ (B) $\frac{1}{10}$
(C) $\frac{-1}{28}$ (D) $\frac{1}{28}$

38. In a city, 60% of the youngsters are engineering graduates and 40% of the youngsters are science graduates. Among the engineering graduates, 45% are self employed where as 30% of the science graduates are self employed. If an youngster is selected at random from that city, who is self employed, then the probability that the person is a science graduate is _____

39. If $u(x, y) = \cos x \cdot \cos hy$ is the real part of an analytic function $f(z) = u(x, y) + i\, v(x, y)$ where $z = x + iy$ and $i = \sqrt{-1}$, then the imaginary part $v(x, y)$ of $f(z)$ is _____
(A) $-\cos x \cdot \cos hy$ (B) $\sin x \cdot \sinh y$
(C) $-\sin x \cdot \sin hy$ (D) $\cos x \cdot \sinh y$

40. The general solution of the differential equation $\frac{dy}{dx} = \cos(x + y - 3)$ is _____
(A) $y = (3 - x) + 2\ \text{Tan}^{-1}(x + c)$
(B) $y = (3 + x) - 2\text{Tan}^{-1}(x + c)$
(C) $y = [\text{Tan}^{-1}(3 - x)] + x + c$
(D) $y = [2\ \text{Tan}^{-1}(3 - x)] + 3x + c$

41. A combinational circuit is divided into two sub sections N_1 and N_2 as shown. The truth table of N_1 is given. Assume that the input combinations $ABC = 101$, and $ABC = 001$ never occur. Find the output expression for Z.

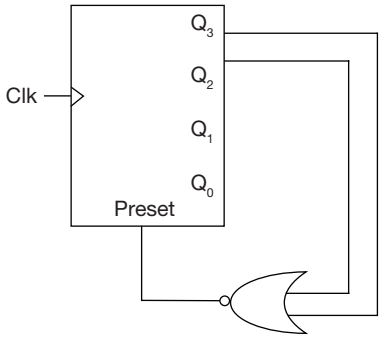


A	B	C	D	E	F
0	0	0	0	0	1
0	0	1	1	0	0
0	1	0	1	1	0
0	1	1	1	1	1
1	0	0	0	0	0
1	0	1	1	0	1
1	1	0	0	1	1
1	1	1	0	1	0

(A) $\overline{A}B+\overline{A}\overline{C}+B\overline{C}$ (B) $\overline{A}+\overline{B}C$

(C) $\overline{A}+B\overline{C}$ (D) $\overline{A}+\overline{B}C+B\overline{C}$

42. A Binary down sequence, asynchronous counter with synchronous and active high preset input is shown in the figure with the decoding logic shown. The counter works as a (consider initially all flip flops at preset state)



(A) Mod – 3 counter (B) Mod – 12 counter

(C) Mod – 13 counter (D) Mod – 14 counter

43. Consider the following statements about DRAM

(1) bit is stored as a charge in capacitor

(2) it is made of BJT as well as MOS transistors

(3) Speed of DRAM is faster than SRAM

(4) 1 bit memory cell requires six transistors

(5) DRAM packing density is more than SRAM

Which of the above statements are correct?

(A) 1 and 5 (B) 2 and 5

(C) 2, 3 and 4 (D) 2, 4 and 5

44. Calculate the frequency at which magnitudes of conduction current density and displacement current density are equal in a material. The material has $\sigma = 5$ *S/m* and $\varepsilon_r = 20$ is subjected to electric field.

(A) 14.1 GHz (B) 4.5 GHz

(C) 56.4 GHz (D) 43.6 GHz

45. The longitudinal component of electric field inside an air filled rectangular wave guide is $E(x, y, z, t) = 10 \sin(40\pi x) \sin(40\pi y) \cos(6\pi \times 10^9 t - \beta z)$V/m. Dimensions of rectangular waveguide 5cm × 2.5cm. The mode of propagation inside the waveguide is

(A) TE_{21} (B) TE_{12}

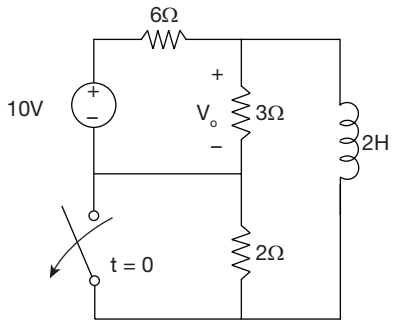
(C) TM_{12} (D) TM_{21}

46. Find the radiation efficiency of a resonant half-wavelength dipole Antenna at 0.5 GHz. Dipole is made up of copper ($\sigma = 5.8 \times 10^7$ S/m) and radius is $\frac{\lambda}{4}$ cm.

(A) 79.3% (B) 99.9%

(C) 87.5% (D) 84.6%

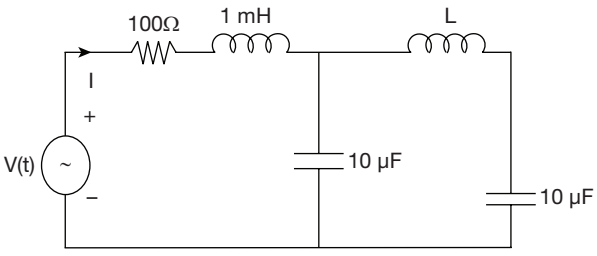
47. Find $V_o(t)$ for $t > 0$



(A) $\frac{5}{3}(1 - e^{0.5t})$volts (B) $\frac{5}{3} \cdot (1 - e^{-2t})$volts

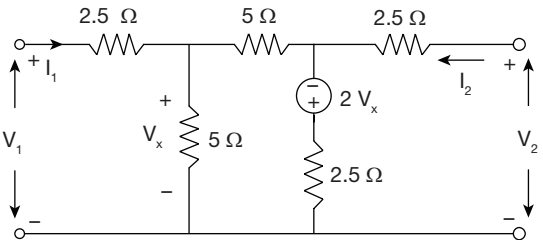
(C) $\frac{5}{3}(1 + e^{-0.5t})$ volts (D) $\frac{3}{5}(1 - 2.\, e^{-2t}\}$ volts

48. In the circuit shown, the current I flowing through the 100 Ω resistor will be zero, If the value of L is _____ H.



(consider $V(t) = 5\sin 1000\, t\, V$)

49. Consider the network show in below



The value of Z_{11}(In Ω) is _____.

50. Depletion capacitance in a diode depends on
1. Built-In-potential
2. junction voltage
3. current through junction
4. carrier concentration

Select the correct answer using the codes given below
(A) 1, 2 and 3 (B) 2, 3 and 4
(C) 1, 2 and 4 (D) 1, 2, 3 and 4

51. The doping concentration on the n-side and p-side of a Si diode are 2.5×10^{16} cm^{-3} and 1×10^{16} cm^{-3}, respectively. A forward bias of 0.4V is applied to the diode. At $T = 300^{o}$ k, the hole concentration at the edge of the depletion region on the n-side is _____.
(Consider $n_i = 1.5 \times 10^{10}$ atoms/cm^3)
(A) 4.32×10^{10} atoms/cm^3
(B) 3.42×10^{9} atoms/cm^3
(C) 4.32×10^{12} atoms/m^3
(D) 3.42×10^{9} atoms/m^3

52. The change in collector voltage is from 1.5V to 3V, while the V_{BE} remains constant. If the collector current change is restricted to be less than are equal to 4%, the necessary value of early voltage is _____.
(A) $V_A \geq 36$ V (B) $V_A \leq 37.5$ V
(C) $V_A \geq 34$ V (D) $V_A \leq 25$ V

53. A unity feedback system has $G(s)H(s) = \dfrac{k}{s(1+as)}$ with 'a' and 'k' are constants. If the peak over shoot value is 50%, then the relation between 'a' and 'k' should be _____.
(A) ak = 2.32 (B) k.a = 5.38
(C) $\dfrac{a}{k} = 4.2$ (D) $\sqrt{ak} = 3.2$

54. The characteristic equation of a feedback control system is $s^3 + (K + 2)\, s^2 + 3Ks + 20 = 0$. If the system is marginally stable, then the frequency of oscillations is _____ rad/sec.

55. Consider the particular system state equation are

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} -1 & 1 \\ 2 & 0 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} 2 \\ 3 \end{bmatrix} u$$

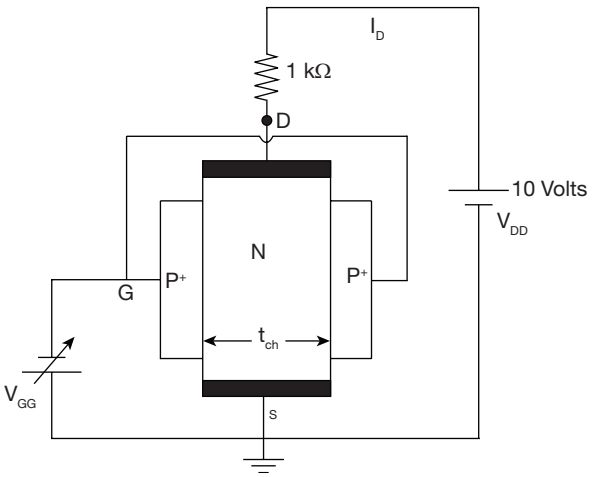
$y = [-1\ 2]\ [x]$
The transfer function of the system is
(A) $\dfrac{2s-13}{s^2+s-2}$ (B) $\dfrac{-4s+13}{s^2+s+2}$
(C) $\dfrac{(4s+11)}{s^2+s-2}$ (D) $\dfrac{-(4s+11)}{s^2+s-2}$

56. If $f(t) = 0$, outside the interval $[T_1, T_2]$ furthermore, $|f(t)| < \infty$, The ROC of the signal's bilateral Laplace transform $F(s)$ is _____
(A) The entire S-plane
(B) A parallel strip – not containing the j axis.
(C) A parallel strip containing the j axis.
(D) None of these

57. A signal is represented by $x(t) = \begin{cases} 1 & ; \ |t| < 2 \\ 0 & ; \ |t| > 2 \end{cases}$
The fourier transform of the convoluted signal $y(t) = x(3t) \otimes x\left(\dfrac{t}{3}\right)$ is_____
(A) $\dfrac{2}{\omega^2} Sa\left(\dfrac{2\omega}{3}\right) Sa(6\omega)$
(B) $\dfrac{4}{\omega^2} Sa\left(\dfrac{2\omega}{3}\right) Sa(6\omega)$
(C) $\dfrac{4}{\omega^2} \mathrm{Sin}\left(\dfrac{2\omega}{3}\right) \mathrm{Sin}(6\omega)$
(D) None of these

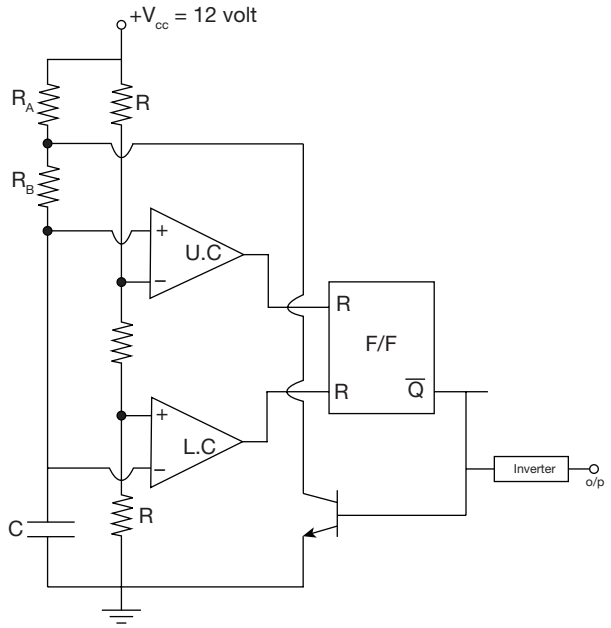
58. Odd part of signal $x[n] = \dfrac{5}{1-3jn} is$ _____
(A) $\dfrac{15\, jn}{1+9n^2}$ (B) $\dfrac{30\, jn}{1-9n^2}$
(C) $\dfrac{j5}{1+9n^2}$ (D) $\dfrac{15\, jn}{1-9n^2}$

59. The channel resistance of an N-channel JFET shown in the figure below is 600 Ω when the full channel thickness (t_{ch}) of 10μm is available for conduction. When V_{GG} is 0V, the channel depleted by 1 μm on each side due to the built in voltage ($V_{bi} = -1$V) when V_{GG} is 3 Volt, the current I_D is



(A) 10 mA
(B) 5 mA
(C) 0 mA
(D) None of these

60. What is the maximum voltage stored by the capacitor in the given circuit shown in figure.

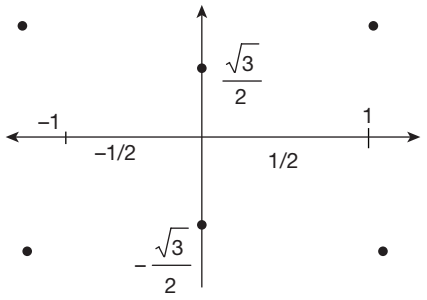


(A) 8 volts (B) 9 volts
(C) 4 volts (D) 3 volts

61. *A* class *B* push pull amplifier supplies power to a resistive load of 12 Ω the output transformer has a turns ratio of 3:1 and efficiency of 78.5%. The maximum power output (consider V_{cc} = 20V) is._____Watt.

62. A Ge semi conductor is radiated with light such that carriers are uniformly generated through out its volume. The semiconductor is doped with one Boron atom in each 10^5 atoms of Ge. The excess carrier concentration in the steady state is 10^{14}/cm^3 and the e-h pair generation rate due to irradiation is 10^{22} *e-h* pairs/cm^3/ sec. Then the minority carriers life time is _____ nano sec. (Consider Ge Density = 4.421×10^{22} atoms/cm^3)

63. An alternative to 8 – PSK signal constellation is given below. Then the 8 – PSK minimum distance is _____



(A) $\frac{\sqrt{3}}{2}\sin\left(\frac{\pi}{4}\right)$ (B) $\frac{3}{\sqrt{2}}\sin\frac{\pi}{8}$

(C) $\frac{\sqrt{3}}{2}\sin\left(\frac{\pi}{8}\right)$ (D) $\frac{3}{\sqrt{2}}\sin\left(\frac{\pi}{4}\right)$

64. In the digital communication system, FSK is used to transmit digital data with frequency 10kHz and 30KHz for binary data 0 and 1. These waveforms will be orthogonal for a bit interval of _____

(A) 100 μ*s* (B) 200 μs
(C) 50 μ*s* (D) 25 μs

65. The most common modulation system used for CDMA and GSM are _____ respectively.

(A) GMSK, spread spectrum
(B) Spread spectrum, GMSK
(C) GMSK, GMSK
(D) None

Answer Keys

1. B	**2.** B	**3.** C	**4.** D	**5.** A	**6.** 68	**7.** C	**8.** A	**9.** C	**10.** D
11. B	**12.** 3	**13.** 1.8	**14.** D	**15.** C	**16.** A	**17.** B	**18.** 4.64 to 4.66		**19.** A
20. B	**21.** B	**22.** 113 to 114		**23.** 0.9 to 1.1		**24.** 0.48 to 0.52		**25.** –1.1 to –0.9	
26. B	**27.** B	**28.** B	**29.** 5.5 to 6.5		**30.** C	**31.** A	**32.** 0.7 to 0.9	**33.** 43 to 44	
34. B	**35.** A	**36.** A	**37.** D	**38.** 0.29 to 0.31		**39.** C	**40.** A	**41.** C	**42.** C
43. A	**44.** B	**45.** D	**46.** B	**47.** B	**48.** 0.15 to 0.25		**49.** 4.1 to 4.2		**50.** C
51. A	**52.** A	**53.** B	**54.** 2.2 to 2.4		**55.** C	**56.** A	**57.** C	**58.** A	**59.** B
60. B	**61.** 1.4 to 1.5		**62.** 9 to 11 53		**63.** B	**64.** A	**65.** B		

Hints and Explanations

1. 'Toxicity' gives the clue to the correct answer. Something which is toxic is detrimental (harmful). Hence it is logical to say that despite its known 'toxicity', lead continues to be used to the detriment of human and environmental health. The word solace (relief; comfort) runs contrary to what is stated in the sentence. The word chagrin (annoyance) is too mild to be used for something which is toxic. The word impediment (hindrance; obstacle) does not make sense here. Choice (B)

2. Volume of the hemisphere = $\left(\frac{1}{2}\right)\left(\frac{4}{3}\right)\pi r^3$

$= \left(\frac{2}{3}\right)(\pi)(7^3)$

Volume of the cylinder = $\pi r^2 h = 7^3\pi$

Total volume = $(\pi)7^3\left[1+\frac{2}{3}\right]=\frac{5\pi}{3}(7^3)$ Choice (B)

3. The study of man is called Anthropology. Form the point, "Anthropology is called ornithology", we can say that Ornithology is the word that is used to refer to Anthropology. Choice (C)

4. Biology is the study of life, Mythology is the study of myths. Archaeology is not the study of antiques, it is the specific study of historic or prehistoric peoples and their cultures by analysis of their antifacts, inscriptions, monuments etc, especially those that have been excavated. Astrology is the study that assumes and attempts to interpret the influence of heavenly bodies on human affairs. Cosmetology is the art or profession of applying cosmetics. Only option D expresses a relationship which is similar to that expressed by the headwords. Choice (D)

5. The reference is to a specific monsoon hence, the definite article 'the' is more appropriate in the first blank. The present perfect continuous tense 'has been showing' is apt in the second blank because here, the reference is to a trend which started sometime in the past and is still continuing. In the third blank, the reference is to something which took place during a specific time period. This is best denoted using the preposition 'over'. The definite article is required in the fourth blank because the reference is to a particular subcontinent. Choice (A)

6. $h\,(12, 11, 8, 16) = 12 \times 11 > 8 \times 16$
$132 > 128$
Remainder when 132 is divided by 128 = 4.
$fg\,(h(12,11,8,16),17,9,16) = fg(4,17,9,16)$
$= f\,(4, 17, 9, 16) \times g\,(4, 17, 9, 16)$
$= 17 \times 4 = 68.$ Ans: 68

7. Options *A* and *B* run contrary to what is stated. Option *D* is incorrect because it is not mentioned that the brain and the lymphatic system are connected 'indirectly'. Only option *C* can be logically inferred from the given sentence. Choice (C)

8. Only statement (i) can be inferred from the given passage. It cannot be inferred from the passage that the government does not consider cyber threats as serious as other security threats. Options (iii) and (iv) are illogicall. Choice (A)

9. There are 33 instances of students leaving out a question (The sum of the 4 numbers in column 5) Exactly 5 students attempted all 4 questions. We distribute there 33 instances over all the remaining 25 students there would be 8 more instances. We can collect them to at the most 8 students.

$\therefore$ The maximum possible number of students who left out at least 2 questions is 8. Choice (C)

10. All I, II and III are appropriate and apt courses of action. Choice (D)

11. The number of ways of selecting one letter each from the words 'FRACTION' and 'DECIMAL' is $8 \times 7 = 56$.
The selected letter in a word will not be in the other word only if the common letters are not selected.
The common letters in the two words are *A*, *C* and *I*.
The number of ways of selecting the letters from the words such that the selected letter in a word should not be in the other word = (The number of ways of selecting a letter from *F*, *R*, *T*, *O* and *N*) × (The number of ways of selecting a letter from *D*, *E*, *M* and *L*)
$= 5 \times 4 = 20$

$\therefore$ The required probability = $\frac{20}{56} = \frac{5}{14}$

Choice (B)

12. We have $\lim_{x\to 3} \log_5\left[4x^3+\sqrt{(3x^4+5x^2+1)}\right]$

$= \log_5\left(\lim_{x\to 3}\left[4x^3+\sqrt{(3x^4+5x^2+1)}\right]\right)$

$= \log_5\left(108+\sqrt{289}\right) = \log_5 125$

$= \log_5 5^3 = 3$ Answer: 3

13. Let $f(x) = x^3 + x^2 + 4x + 4 = 0$
One can observe that $x = -1$ is a real root of $f(x) = 0$
and $f(x) = (x+1)(x^2+4) = 0$

$\therefore$ $x = -1$ is the only real root of $f(x) = 0$

$f'(x) = 3x^2 + 2x + 4$

Given $x_0 = 2$

$\therefore$ $f(x_0) = f(2) = 24$ and $f'(x_0) = f'(2) = 20$

By Newton-Raphson method the root of $f(x) = 0$ after first iteration is

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$$

$$= 2 - \frac{24}{20} = 2 - \frac{6}{5} = \frac{4}{5}$$

$x_1 = 0.8$

$\therefore$ The absolute error = $|-1 - 0.8| = 1.8$.

Answer: 1.8

14. Standard Result Choice (D)

15. Given $|\bar{F}| = f$ and $|\bar{G}| = g$

$$(\bar{F}-\bar{G})\times(\bar{F}+\bar{G})^2 = \left|(\bar{F}\times\bar{F}+\bar{F}\times\bar{G}-\bar{G}\times\bar{F}-\bar{G}\times\bar{G})\right|^2$$

$$= \left|\left(\bar{O}+\bar{F}\times\bar{G}-\left(-\left(\bar{F}\times\bar{G}\right)\right)-\bar{o}\right)\right|^2$$

$$\left|\bar{0}+\bar{F}\times\bar{G}-(-(\bar{F}\times\bar{G}))-\bar{0})\right|^2$$

$(\because\ \bar{A}\times\bar{A} = \bar{O}$ and $\bar{A}\times\bar{B} = -\bar{B}\times\bar{A})$

$$= \left|(\bar{F}\times\bar{G}+\bar{F}\times\bar{G})\right|^2 = \left|2(\bar{F}\times\bar{G})\right|^2$$

$$= 4\left|\left|\bar{F}\right|\left|\bar{G}\right|\text{Sin}\,\theta\,\hat{n}\right|^2$$

(where θ is the angle between $\bar{F}$ and $\bar{G}$ and $\hat{n}$ is the unit vector perpendicular to the plane containing $\bar{F}$ and $\bar{G}$)

$$= 4\left|fg\sin\theta\,\hat{n}\right|^2 = 4f^2g^2\sin^2\theta\left|\hat{n}\right|^2$$

$$= 4f^2g^2(1-\cos^2\theta) \qquad (\because \left|\hat{n}\right| = 1)$$

$$= 4f^2g^2\left(1-\left[\frac{\bar{F}.\bar{G}}{\left|\bar{F}\right|\left|\bar{G}\right|}\right]^2\right) = 4f^2g^2\left(1-\frac{(\bar{F}.\bar{G})^2}{(fg)^2}\right)$$

$$= 4[f^2g^2 - (\bar{F}.\bar{G})^2]$$ Choice (C)

16. Given circuit is a ripple counter, $\overline{Q}_0$ is connected to rising edge Clk pulse, so it is UP counter.

Clk	Q_1	Q_0
0	0	0
1	0	1
2	1	0
3	1	1
4	0	0

Choice (A)

17. The boiler temperature or pressure when exceeds a specific maximum value, then alarm has to be activated. Pressure, temperature sensors produce HIGH voltage (Logic 1) when exceeds maximum value. Alarm requires low voltage (Logic 0) to get activated.

The above circuit can be implemented by NOR gate.
Choice (B)

18. Given 5 bit *D* to *A* converter.
Analog output V_o = resolution × input in decimal for 01000 input, output is 1.2 V
So 1.2 V = resolution × 8
Resolution = 0.15 V
Full scale reading = resolution × (maximum input)
= 0.15
$(2^5 - 1)$= 4.65 Volts Ans: 4.64 to 4.66

19. In *TE* mode characteristic results

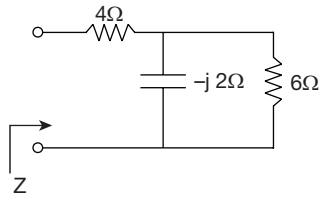
$$Z_o = \frac{\eta}{\sqrt{1-\left(\frac{f_o}{f}\right)^2}}$$

$$f_o = \frac{C}{2a} = \frac{3\times10^{10}}{2\times2.5} = 6\ GHz$$

$$Z_o = \frac{377}{\sqrt{1-\left(\frac{6}{8}\right)^2}} = 570\ \Omega$$ Choice (A)

20. Field is propagating in *x* axis but polarized in *y*-axis because the polarization of wave in the orientation of *E*. Choice (B)

21. Find the total impedance



$$Z = 4 + \{6 \parallel -j2\}$$

$$Z = 4 + \frac{-j2\times6}{6-j2}$$

$$Z = (4.6 - j1.8)\ \Omega$$

$$Z = 4.93\ \angle\ -21.37^o\ \Omega$$

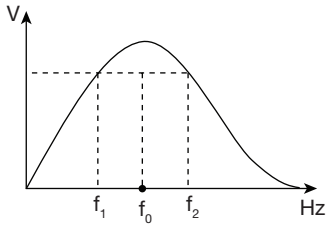
Power factor $p.f$ = cos θ = cos(-21.37)
= 0.9312 (Leading)
Average power supplied by the source is

$$P = V_{rms}.I_{rms}.p.f = I_{rms}^2.R$$

$$I_{rms} = \frac{V_{rms}}{Z} = \frac{20}{4.93\angle-21.37} = 4.05\angle21.37^o\ \text{Amp}$$

$P = (4.05)^2 \times 4.6 = 75.7$ W Choice (B)

22.



$$BW = f_2 - f_1$$

$$\therefore \quad f_2 = f_0 + \frac{BW}{2}$$

We know for RLC series circuits characteristic equation $S^2 + \frac{R}{L}S + \frac{1}{LC} = 0$

$$\omega_o = \frac{1}{\sqrt{LC}}\ \text{rad/sec or}\ f_o = \frac{1}{2\pi\sqrt{LC}}$$

$$= \frac{1}{2\pi\times1.549\times10^{-3}} = 102.73\ \text{Hz}$$

$$BW = \frac{R}{L}\ \text{or}\ BW = \frac{1}{2\pi}.\frac{R}{L}$$

$$= \frac{1}{2\pi} \times \frac{40}{0.3}$$

$BW = 21.22$ Hz

$$\therefore \quad f_2 = 102.73 + \frac{21.22}{2}$$

$= 113.34$ Hz Answer range 113 to 114

23. Convert Y to Δ

$$Z_a = 2 + j3 - \frac{2 \times j3}{j2} = 2 + j3 - 3 = (-1 + j3)\ \Omega$$

$$Z_b = 2 - j2 + \frac{2 \times (-j2)}{j3} = \left(\frac{2}{3} - j2\right)\Omega$$

$$Z_C = j3 - j2 + \frac{j3(-j2)}{2} = (3 + j1)\ \Omega$$

$$\left|\frac{Z_a}{Z_c}\right| = 1$$

Ans: 0.9 to 1.1

24. $I_C = \beta . I_B + (1 + \beta) . I_{CBO}$

$2.5 \times 10^{-3} = 100 \times 20 \times 10^{-6} + I_{CEO}$

$I_{CEO} = 0.5 \times 10^{-3} = 5 \times 10^{-4}$

$= 0.5$ mA Ans: 0.48 to 0.52

25. We know in general

$$g_m = g_{mo}\left[1 - \frac{V_{GS}}{V_P}\right]$$

$$1.5 \times 10^{-3} = 2 \times 10^{-3}\left[1 - \frac{V_{GS}}{-4}\right]$$

$0.75 = 1 + 0.25\ V_{GS}$

$V_{GS} = -1$V

Ans: –1.1 to –0.9

26. $G(s)\,H(s) = \dfrac{K}{(s+3)(s^2+2s+2)}$

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

$(s + 3)(s^2 + 2s + 2) + K = 0.$

Closed loop poles nothing but roots of characteristic equation. So Sub s = –4

$(-1)(16 - 8 + 2) + K = 0.$

$K = 10.$

Choice (B)

27. Initial slope $\Rightarrow$ – 40 db / dec, so $P = 2$.

2nd Slope changing from –40 db/dec to 0 db/dec, so $Z = 2$.

Again slope changing from 0 db/dec to + 20 *db*/dec, $Z = 1$

Next + 20 db/dec to – 20 db/dec ;so $P = 2$

$\therefore$ total $P = 2+2 = 4$.

$Z = 2+1 = 3$.

Choice (B)

28. $X(z) = \dfrac{1}{1 - z^{-3}}$

$= z^{+3} + z^{+6} + z^{+9} \ldots\ldots$

So $x[-1] = 0$

$x[-3] = 1$

Choice (B)

29. Nyquist frequency for $x_1(t)$

$= 400\pi + 800\pi = 1200\pi$ (or) 600 Hz

Nyquist frequency for $x_2(t) = 200\pi$ (or) 100 Hz

Now $\dfrac{N_1}{N_2} = \dfrac{600}{100} = 6$

Ans: 5.5 to 6.5

30. Choice (C)

31. Choice (A)

32. From the given data series – shunt is nothing but Voltage – series.

So $R_{in}^1 = R_{in}(1 + A\beta) = z_{if}$

$$R_0^1 = \frac{R_0}{(1 + A\beta)} = z_{of}$$

$$\therefore \quad \frac{Z_{if}}{Z_{of}} = \frac{Z_i}{Z_0} \times (1 + A\beta)^2 = \frac{(1+1)^2}{5} = \frac{4}{5} = 0.8$$

Ans: 0.7 to 0.9

33. No. of quantization levels $q = 512$

So no of bits $\Rightarrow 512 = 2_n$

$n = 9$

$f_m = 2.4$MHz

Sampling frequency $f_s = 2f_m = 4.8$MHz

So find bit rate $= nf_s$

$r_b = 9 \times 4.8 \times 10^6$bits/sec

$= 43.2$Mbps Ans: 43 to 44

34. As we know that the local oscillater frequency is always greater than the fifth frequency.

So frequency of $L.0_2 = (13.4 \times 10^3 + 455)$ KHz

$= 13.855$ MHz

Now, frequency of L.0.1 = (29.4 + 13.4)MHz

$= 42.8$MHz

Choice (B)

35. $Y \le y$ if and only if $X \le \dfrac{(y-b)}{a}$

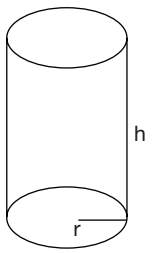
$$FY(y) = P(Y \le y) = P\left(X \le \frac{y-b}{a}\right) = Fx((Y-b)/a)$$

After differentiating both sides

$$F_Y(y) = \frac{1}{a} fx\left((y-b)/a\right)$$

Choice (A)

36.



Let r and h be the radius and height of the cylindrical cistern with surface = 108π sq. feet

$\therefore \quad 2\pi rh + \pi r^2 = 108\pi$

$\Rightarrow \quad 2rh = 108 - r^2$

$\Rightarrow \quad h = \dfrac{108 - r^2}{2r} \quad \rightarrow (1)$

Volume of the cylindrical cistern = $C = \pi r^2 h$

$= \pi r^2 \left(\dfrac{108 - r^2}{2r}\right)$

$\therefore \quad V = \dfrac{\pi}{2}(108r - r^3) \rightarrow (2)$

Let $f(r) = \dfrac{\pi}{2}(108r - r^3)$

$\therefore$ We have to find the maximum value of V.

$f'(r) = \dfrac{\pi}{2}(108 - 3r^2)$

$f'(r) = 0 \Rightarrow \dfrac{\pi}{2}(108 - 3r^2) = 0$

$\Rightarrow \quad 108 - 3r^2 = 0$

$\Rightarrow \quad r^2 = 36$

$\Rightarrow \quad r = 6$

And $f''(r) = -3\pi r < 0$ for $r = 6$

$\therefore \quad f(r)$ is maximum at $r = 6$

Hence the maximum volume of the cistern

$= V$ at $x = 6$

$= \dfrac{\pi}{2}(108 \times 6 - 6^3)$

$= 216\pi$ cubic feet. Choice (A)

37. Given -1, 2 and 5 are the eigen values of A.

$\therefore \quad -1 + 2$, $2 + 2$ and $5 + 2$ are the eigen values of $A + 2I_3$

i.e., 1, 4 and 7 are the eigen values of $A + 2I_3$

$\therefore \quad$ Det $(A + 2I_3) = |A + 2I_3|$ = Product of the eigen values of $A + 2I_3$

$= 1 \times 4 \times 7 = 28$

$\Rightarrow \quad$ Determinant of inverse of $A + 2I_3$

$= |(A + 2I_3)^{-1}| = \dfrac{1}{|A + 2I_3|} = \dfrac{1}{28}$ Choice (D)

38. Let B_1 and B_2 denote the events of selecting an engineering graduate and a science graduate respectively. Let A be the event of selecting a youngster who is self employed.

$\therefore \quad P(B_1) = \dfrac{60}{100} = 0.6$, $P(B_2) = \dfrac{40}{100} = 0.4$

$P(A/B_1) = \dfrac{45}{100} = 0.45$ and $P(A/B_2) = \dfrac{30}{100} = 0.3$

If the youngster selected is found to be self employed, then the probability that the person is a science graduate

$= P(B_2/A) = \dfrac{P(B_2).P(A/B_2)}{P(B_1).P(A/B_1) + P(B_2).P(A/B_2)}$

(By Baye's Theorem)

$= \dfrac{0.4 \times 0.3}{(0.6 \times 0.45) + (0.4 \times 0.3)}$

$= \dfrac{12}{39} = 0.3077$ (Answer: 0.29 to 0.31]

39. Given $f(z) = u(x, y) + i\, v(x, y)$ is analytic and $u(x, y) = \cos x . \cosh y$.

$\therefore \quad \dfrac{\partial u}{\partial x} = u_x = -\sin x . \cosh y$

and $\dfrac{\partial u}{\partial y} = u_y = \cos x . \sin hy$

As $f(z)$ is analytic, $u(x, y)$ and $v(x, y)$ will satisfy Cauchy – Reimann equations.

i.e., $u_x = v_y$ and $v_x = -u_y$ $\rightarrow (1)$

we know that $dv = \dfrac{\partial v}{\partial x}dx + \dfrac{\partial v}{\partial y}dy$

$= v_x\, dx + v_y\, dy = -u_y dx + u_x dy$ (From (1))

$= -(\cos x . \sin hy)\, dx + (-\sin x . \cos hy)\, dy$

$\therefore \quad dv = -\cos x . \sin hy\, dx - \sin x . \cosh y\, dy$

$= -d(\sin x . \sin hy)$

$\Rightarrow \quad v(x, y) = -\sin x . \sin hy$ Choice (C)

40. Given differential equation is

$\dfrac{dy}{dx} = \cos(x + y - 3) \quad \rightarrow (1)$

Put $x + y - 3 = u$

Differentiating w.r.t x on both sides, $1 + \dfrac{dy}{dx} = \dfrac{du}{dx}$

$\Rightarrow \quad \dfrac{dy}{dx} = \dfrac{du}{dx} - 1$

$\therefore \quad$ (1) becomes, $\dfrac{du}{dx} - 1 = \cos u$

$\Rightarrow \quad \dfrac{du}{dx} = 1 + \cos u$

$\Rightarrow \quad \dfrac{1}{(1 + \cos u)}\, du = dx$

$\Rightarrow \quad \dfrac{1}{2\cos^2\left(\dfrac{u}{2}\right)}\, du = dx$

$\Rightarrow \quad \dfrac{1}{2}\sec^2(u/2)\, du = dx$

Integrating on both sides,

$\dfrac{1}{2}\int \sec^2\left(\dfrac{u}{2}\right) du = \int dx$

$\Rightarrow \quad \dfrac{1}{2}\left(\dfrac{\tan\left(\dfrac{u}{2}\right)}{\dfrac{1}{2}}\right) = x + c$

$\Rightarrow \quad \tan\left(\frac{x+y-3}{2}\right) = x + c$

$\Rightarrow \quad \frac{x+y-3}{2} = \text{Tan}^{-1}(x+c)$

$\Rightarrow \quad x + y - 3 = 2\ \text{Tan}^{-1}(x+c)$

$\Rightarrow \quad y = (3-x) + 2\ \text{Tan}^{-1}(x+c)$

$\therefore$ The general solution of (1) is

$y = (3-x) + 2\ \text{Tan}^{-1}(x+c)$ Choice (A)

41. From the given circuit $Z = DE + F$

We need expression of Z in terms of A, B, C

$ABC = 101, 001$ combinations do not occur.

A	B	C	D	E	F	$Z = DE + F$
0	0	0	0	0	1	1
0	0	1	1	0	0	X
0	1	0	1	1	0	1
0	1	1	1	1	1	1
1	0	0	0	0	0	0
1	0	1	1	0	1	X
1	1	0	0	1	1	1
1	1	1	0	1	0	0

$Z(A, B, C) = \Sigma\, m(0, 2, 3, 6) + \phi(1, 5)$

A \ BC	00	01	11	10
0	1	X	1	1
1		X		1

$Z = \overline{A} + B\overline{C}$ Choice (C)

42. Active high preset, so when output of NOR gate is 1, then preset activated, and output becomes 1111 is next clk pulse (synchronous input)

Clk	Q3	Q2	Q1	Q0	Preset= $\overline{Q_3 + Q_2}$
0	1	1	1	1	0
1	1	1	1	0	0
2	1	1	0	1	0
10	0	1	0	1	0
11	0	1	0	0	0
12	0	0	1	1	1
13	1	1	1	1	0

From the above table, we can understand that after 13 clk pulse the counter came to original state. So it is Mod 13 counter Choice (C)

43. DRAM is made of MOS transformers only, SRAM is faster than DRAM, 1 bit DRAM cell requires 1 transistor, 1 capacitor. Choice (A)

44. Given $|J_c| = |J_d|$

$\sigma . E = \omega \in E$

$f = \frac{\sigma}{2\pi \in_r E_0} = \frac{5 \times 36\pi \times 10^9}{2\pi \times 20 \times 1}$

$f = 4.5$ GHz Choice (B)

45. Rectangular wave

$E(x, y, z, t)$

$= 10 \cos\left(\frac{m\pi}{a}x\right)\sin\left(\frac{n\pi}{b}y\right)\sin(\omega t - \beta z)$ A/m

$\frac{m\pi}{0.05} = 40\pi$

$m = 2$

$\frac{n\pi}{b} = 40\pi$

$\Rightarrow \quad n = 40 \times 0.025 = 1$

As the e-field is longitudinal the mode is TM.

So the mode will be TM_{21}. Choice (D)

46. Radiation efficiency $= \frac{R_{rad}}{R_{rad} + R_L}$

Where $R_L = \frac{1}{2}R_{hf} = \frac{\ell}{2\pi a}\sqrt{\frac{\omega\mu_o}{2\sigma}} = 0.058\ \Omega$

$R_{rad} = 73\ \Omega$ for half-wavelength

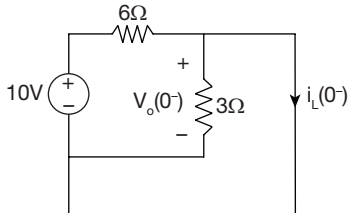
$\eta_{rad} = \frac{73}{73 + 0.058} = 0.999 = 99.9\%$ Choice (B)

47. **For $t < 0$:**

Switch closed and the circuit is in S.S

$L \rightarrow S.C$

The equivalent circuit is shown in below

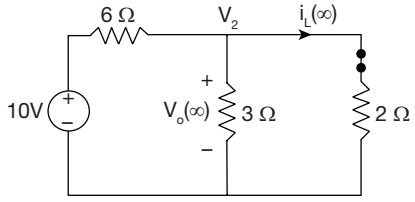


$i_L(0^-) = \frac{10}{6} = \frac{5}{3}A$

$V_o(0^-) = 0\text{V}$

$t \rightarrow \infty$

$i_L(\infty) = ?$



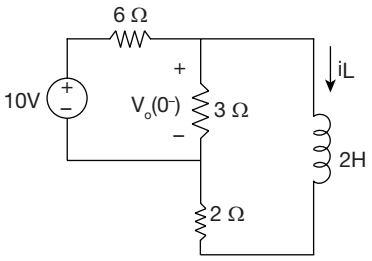
$\frac{V_o(\infty) - 10}{6} + \frac{V_o(\infty)}{3} + \frac{V_o(\infty)}{2} = 0$

$V_o(\infty) - 10 + 2V_o(\infty) + 3V_o(\infty) = 0$

$6V_o(\infty) = 10$

$V_o(\infty) = \frac{5}{3}V$

For $t > 0$:



$V_o(t) = V_0(\infty) + \{V_o(0^+) - V_0(\infty)\}.e^{-t/\tau}$

$\tau = \dfrac{L_{eq}}{R_{eq}}$; $R_{eq} = (6||3) + 2$

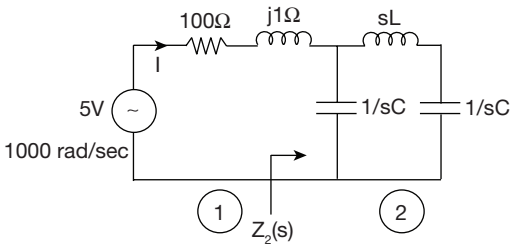
$R_{eq} = 4\ \Omega$

$L = 2\ H$

$\tau = \dfrac{1}{2}$ sec

$\therefore \quad V_o(t) = \dfrac{5}{3}\{1 - e^{-2t}\}$ volts Choice (B)

48. Redraw the given circuit the S-domain



$Z_2(s) = \left(\dfrac{1}{sC}\right) || \left(sL + \dfrac{1}{sC}\right)$

$Z_2(s) = \dfrac{\dfrac{1}{sC}\left\{\dfrac{s^2LC+1}{sC}\right\}}{\dfrac{1}{sC} + \dfrac{1}{sC} + sL}$

But given $I = 0$

$I = 0$, only when $Z_2(s) = \infty$ [open circuit]

$Z_2(s) = \dfrac{X}{2 + s^2\,LC}$

Let $2 + S^2\,LC = 0$

$S = j\omega$

$2 - \omega^2 LC = 0$

$\omega = \sqrt{\dfrac{2}{LC}}$

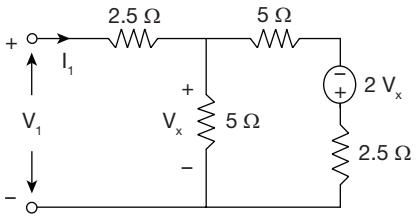
$(1000)^2 = \dfrac{2}{LC}$

$L = \dfrac{2}{10^6 \times 10 \times 10^{-6}}$

$L = 0.2$ H Ans: 0.15 to 0.25

49. We know $Z_{11} = \dfrac{\dfrac{V_1}{I_1}}{I_2 = 0}$

Redraw the given circuit



From the circuit

$V_1 - 2.5I_1 - V_x = 0$ and $-I_1 + \dfrac{V_x}{5} + \dfrac{3V_x}{7.5} = 0$

$15I_1 = 3V_x + 6V_x$

$9V_x = 15\,I_1$

Sub $V_x = \dfrac{5}{3}I_1$

$V_1 - 2.5\,I_1 - \dfrac{5}{3}I_1 = 0$

$\dfrac{V_1}{I_1} = Z_{11} = 4.166\ \Omega$ Ans: 4.1 to 4.2

50. $C_T = \dfrac{\in A}{d} = \dfrac{\in A}{W}$

$W = \sqrt{\dfrac{2\in_s}{q}\left[\dfrac{1}{N_A} + \dfrac{1}{N_D}\right].V_j}$

It is not depends on the forward current. Choice (C)

51. $P_n = P_{no}.exp\left\{\dfrac{V_f}{V_T}\right\}$

$P_{no} = \dfrac{n_i^2}{N_D} = \dfrac{\left(1.5 \times 10^{10}\right)^2}{2.5 \times 10^{16}} = 9 \times 10^3$

$P_n = 9 \times 10^3 \exp\left\{\dfrac{0.4}{0.026}\right\}$

$P_n = 4.32 \times 10^{10}\ cm^{-3}$ Choice (A)

52. $I_C = I_{CO}.e^{\left[V_{BE}/V_T\right]}.\left[1 + \dfrac{V_{CE}}{V_A}\right]$

Given V_{BE} = constant

$\Delta I_C = I_{CO}.e^{\left[V_{BE}/V_T\right]}.\left[\dfrac{\Delta V_{CE}}{V_A}\right]$

$\dfrac{\Delta I_C}{I_C} = \dfrac{\Delta V_{CE}}{V_A + V_{CE}}$

Given $\dfrac{\Delta I_C}{i_c} \le 4\%$

$$\therefore \quad \frac{\Delta V_{CE}}{V_A + V_{CE}} \le \frac{1}{25}$$

$25(\Delta V_{CE}) \le V_A + V_{CE}$
$\Delta V_{CE} = 3 - 1.5 = 1.5$ V
$V_{CE\,min} = 1.5$ V
$25 \times 1.5 \le V_A + 1.5$
$V_A \ge 36$ V Choice (A)

53. Characteristic equation 1 + G.H = 0.
$s(1 + as) + k = 0 \Rightarrow as^2 + s + k = 0$

$$s^2 + \frac{1}{a}.s + \frac{k}{a} = 0$$

$$2\xi\omega_n = \frac{1}{a};\ \omega_n = \sqrt{\frac{k}{a}}$$

$$M_p = e^{\frac{-\xi\pi}{\sqrt{1-\xi^2}}} \times 100$$

$$0.5 = e^{\frac{-\xi\pi}{\sqrt{1-\xi^2}}} \quad -0.693 = -\frac{\xi\pi}{\sqrt{1-\xi^2}}$$

$0.048\,(1 - \xi^2) = \xi^2$
$0.048 = 1.0486\xi^2$
$\xi = 0.2154$

$$\frac{1}{2\sqrt{ka}} = 0.2154$$

$\sqrt{ka} = 2.32$
$ka = 5.3814$ Choice (B)

54. The routh array is

s^3	1	$3K$
s^2	$K + 2$	20
s^1	$3k - \frac{20}{K+2}$	
s^0	20	

If the system is stable only when

$$K + 2 > 0 \text{ and } 3K - \frac{20}{K+2} > 0.$$

$3K^2 + 6K - 20 > 0$
$K > 1.76$ and $K > -3.768$
From the above conditions, the system is stable for $k > 1.76$
If $K = 1.76$, the system is marginally stable
$(K + 2)S^2 + 20 = 0$
sub $K = 1.76 - 3.76(\omega^2) + 20 = 0$
$\sigma\psi\mu^2 = 5.319$
$\omega_o = 2.3$ rad/sec Ans: 2.2 to 2.4

55. $\frac{Y(s)}{X(s)} = T(s) = C.(SI - A)^{-1}.B + D$

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

$$(SI - A) = \begin{bmatrix} s+1 & -1 \\ -2 & s \end{bmatrix}$$

$$(sI - A)^{-1} = \frac{adj\,(sI - A)}{|sI - A|} = \frac{1}{s(s+1) - 2}\begin{bmatrix} s & 1 \\ 2 & s+1 \end{bmatrix}$$

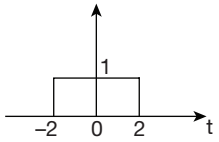
$$\therefore \quad T(s) = \begin{bmatrix} -1 & 2 \end{bmatrix}\begin{bmatrix} s & 1 \\ 2 & s+1 \end{bmatrix}\begin{bmatrix} 2 \\ 3 \end{bmatrix}\frac{1}{s^2 + s - 2}$$

$$T(S) = \frac{-2s - 3 + 2(3s + 7)}{s^2 + s - 2}$$

$$T(A) = \frac{6s - 2s - 3 + 14}{s^2 + s - 2} = \frac{(4s + 11)}{s^2 + s - 2}$$ Choice (C)

56. For a finite duration signal ROC is entire S-plane
Choice (A)

57. $x(t) = \text{rect}\left(\frac{t}{\tau}\right) = \text{rect}\left(\frac{t}{4}\right)$



$$\therefore \quad \text{rect}\left(\frac{t}{\tau}\right) = \tau Sa\left(\frac{\omega\tau}{2}\right)$$

$$\text{rect}\left(\frac{t}{4}\right) = 4\ \text{Sa}\left(\frac{\omega.4}{2}\right) = 4Sa(2\ \omega)$$

By using scaling property of fourier transform

$$F\{x(3t)\} = F[rect\left(\frac{3t}{4}\right)] = 4 \times \frac{1}{3}\,\text{Sa}\left(\frac{2\omega}{3}\right)$$

$$\text{Similarly } F\left(x\left(\frac{t}{3}\right)\right) = F\left(rect\left(\frac{t}{12}\right)\right)$$

$= 4.3Sa(2\ \omega.3) = 12\ Sa\ (6\ \omega)$

$$F(y(t)) = F[x(3t)]\ .\ F\left[x\left(\frac{t}{3}\right)\right]$$

$$= \frac{4}{3}.12\,Sa\left(\frac{2\omega}{3}\right).sa(6\omega)$$

$$= \frac{16}{\frac{2\omega}{3}.6\omega}\sin\left(\frac{2\omega}{3}\right).\sin(6\omega)$$

$$= \frac{4}{\omega^2}\sin\left(\frac{2\omega}{3}\right)\sin(6\omega)$$ Choice (C)

58. $x[n] = \frac{5}{1 - 3jn}$

$$x[-n] = \frac{5}{1 + 3jn}$$

$$\text{So } x_0[n] = \frac{1}{2}[x(n) - x[-n]]$$

$$= \frac{1}{2}\left[\frac{5}{1-3jn} - \frac{5}{1+3jn}\right] = \frac{5}{2}\left[\frac{6jn}{(1+9n^2)}\right]$$

$$= \frac{15\,jn}{(1+9n^2)}$$

Choice (A)

59. $I_D = \dfrac{V_{DD}}{1k\Omega + R_{Ch}}$

$R_{Ch} \alpha \dfrac{1}{t_{Ch}}$

$\dfrac{R_{Ch_1}}{R_{Ch_2}} = \dfrac{t_{Ch_2}}{t_{Ch_1}}$

When $V_{GG} = 0$ $t_{Ch_1} = 10$ µm

When $V_{GG} = 3$ volt

$t_{Ch_2} = 10\,\mu m - 2W_2$

$W\ \alpha\ \sqrt{V_{GS} + V_{bi}}$

$\dfrac{W_1}{W_2} = \sqrt{\dfrac{V_{GS1} + V_{bi}}{V_{GS2} + V_{bi}}}$

$\dfrac{1}{W_2} = \sqrt{\dfrac{0-1}{-3-1}} \Rightarrow W_2 = 2$ µm

$t_{Ch_2} = 10\,\mu m - 2 \times 2\,\mu m = 6$ µm

$R_{Ch_2} = \dfrac{R_{Ch_1} \times t_{Ch_1}}{t_{Ch_2}}$

$= \dfrac{600 \times 10}{6}$

$R_{Ch_2} = 1000\Omega$

$I_D = \dfrac{10}{1\text{k}\Omega + 1\text{k}\Omega} = 5\,\text{mA}$

Choice (B)

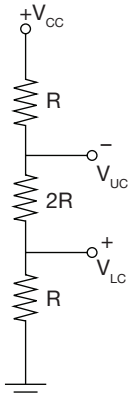
60. In the given circuit

$\mathbf{V}_{UC}^{-} = \dfrac{V_{cc}\,3R}{4R} = \dfrac{3}{4}V_{cc}$

$V_{LC}^{+} = \dfrac{V_{cc} \times R}{4R} = \dfrac{V_{cc}}{4}$

The voltage V_C across capacitor varies between $\dfrac{V_{cc}}{4} \rightarrow \dfrac{3V_{cc}}{4}$

$V_{Cmax} = \dfrac{3}{4}V_{cc} = \dfrac{3}{4} \times 12 = 9\,\text{Volt}$



Choice (B)

61. $R_L = 12\ \Omega$, $n = \dfrac{N_2}{N_1} = \dfrac{1}{3} = 0.333$, $\eta_{trans} = 78.5\%$

$R_L^1 = \dfrac{R_L}{(n)^2} = 108\Omega$

For P_{max}, $V_m = V_{CC}$

$(P_{ac})_{max} = \dfrac{1}{2}\dfrac{(V_{cc})^2}{R_L^1} = \dfrac{1}{2}\dfrac{(20)^2}{108} = 1.8518$ W

But $\eta_{trans} = 78.5\%$

$P_L = \eta_{trans} \times (P_{ac})_{max} = 0.785 \times 1.8518$

$= 1.4537$ W

Ans: 1.4 to 1.5

62. From the given data

$\Delta p = 10^{14}$ cm^{-3}

$g = 10^{22}$

$g = \dfrac{\Delta p}{\tau_p}$

$\tau_p = \dfrac{10^{14}}{10^{22}} = 10^{-8}\,sec$

$\tau_p = 10\,ns$

Answer range: 9 to 11

63. From the signal constellation above we get average signal energy

$$E = \frac{1}{8}\left[4\left(1^2 + \left(\frac{\sqrt{3}}{2}\right)^2\right) + 2\left(\frac{\sqrt{3}}{2}\right)^2 + 2\left(\frac{1}{2}\right)^2\right] = \frac{9}{8}$$

So 8 – PSK minimum distance is

$dpsk = 2\sqrt{E}\,\text{Sin}\left(\dfrac{\pi}{8}\right) = \dfrac{3}{\sqrt{2}}\text{Sin}\left(\dfrac{\pi}{8}\right)$

Choice (B)

64. In FSK,

$f_H = 30$ KHz

$f_L = 10$ KHz

now as we know that

Let $f_H = f_2$

$f_L = f_1$

$f_2 - f_1 = nf_b$

$20{,}000 = \dfrac{n}{T_b}$

$T_b = \dfrac{n}{20000}\,(n = 1, 2, 3, \ldots\ldots\ldots)$

At $n = 2$

$T_b = 100\ \mu s$

Choice (A)

65. CDMA uses spread spectrum modulation which are in pseudo rando fashion.

GSM uses GMSK (Gaussian minimum shift key which is a continuous – phase frequency shift keying.

Ans: Spread spectrum and GMSK.

Choice (B)