ANALYSIS OF GATE 2021
Memory Based

Instrumentation Engineering

- General Aptitude 15%
- Engineering Mathematics 11%
- Digital Circuits 8%
- Control System 6%
- Signal and System 8%
- Network Theory 4%
- Analog Electronics 8%
- Communications 3%
- Measurements 12%
- Transducers 8%
- Process Control 1%
- Optical Instrumentation 5%
- Electro-Magnetic Theory 5%
- Electrical Machines 6%
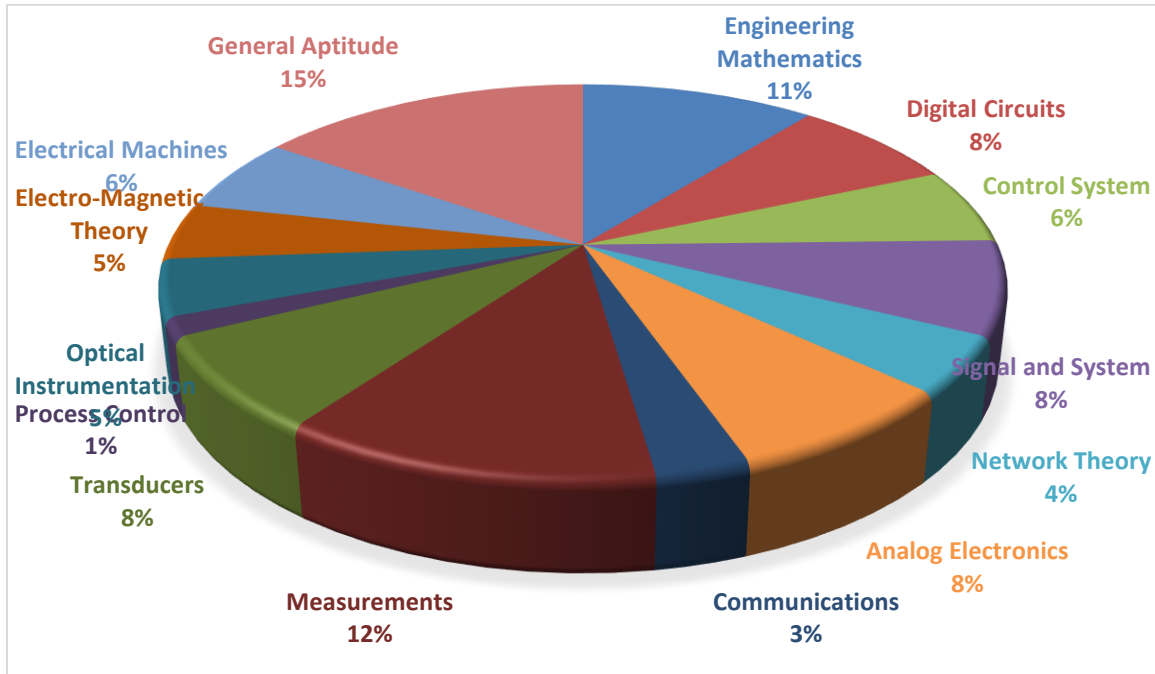
IN ANALYSIS-2021_Feb-6_Morning

SUBJECT	No. of Ques.	Topics Asked in Paper (Memory Based)	Level of Ques.
Engineering Mathematics	7	Complex variable Probability density, limit, Determinant function	
Digital Circuits	5	ATOD or D/A converter, flash type ADC, multiplexer	Easy
Control System	4	Time response Analysis	Medium
Signal and System	5	Laplace transformer, Basic properties of signal	Easy
Network Theory	3		Easy
Analog Electronics	5	Application of op-amp amplifier	Medium
Communications	2	PCM, AM-power, random variable	Easy
Measurements	8	AC, bridge	
Transducers	5	Pressure measurement, temperature measurement, resistive, capacitive and inductive transducer	
Process Control	1	PID controller	
Optical Instrumentation	3	Laser, optical fiber, interferometer	
Electro-Magnetic Theory	3	Line current, magnetic circuit	Medium
Electrical Machines	4		Medium
General Aptitude	10		Easy
Total	65		
Faculty Feedback	one mark and 2 marks questions of technical section were mixed. Total MCQ were 19, NAT 32, MSQ – 4, GA all are MCQ questions		

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GATE 2021 Examination* (Memory Based)

Instrumentation Engineering

Test Date: 6th Feb 2021

Test Time: 09:30 am to 12:30 pm

Stream Name: Instrumentation Engineering

General Aptitude

1. Let $\oplus$ and $\odot$ are two operators on p and q

    $p \oplus q = \dfrac{p^2 + q^2}{pq}$ and $p \odot q = \dfrac{p^2}{q}$

    If $x \oplus y = 2 \odot 2$, then x will be equal to
    (A) 2y
    (B) y/2
    (C) 3y/2
    (D) y
    [Ans. D]

2. Getting to the top is _____ than staying on top.
    (A) easier
    (B) more easier
    (C) easiest
    (D) much easier
    [Ans. A]

3. Two papers M and N have identical dimension of 6m ∗ 4m.
    Operation 1: Folded the paper joining the short sides
    Operation 2: Folded the paper joining the longer sides.
    If operation 1 is done on paper M and operation 2 is done on paper N, then the ratio of perimeter of paper N to M is
    (A) 5: 13
    (B) 3: 2
    (C) 7: 5
    (D) 13: 7
    [Ans. D]

4. Humans have the ability to construct worlds entirely in their mind, which does not exist in the physical world. So far as we know, no other species possess this. This skill is so important that we have different words to refer to its different flavours such as imagination invention and innovation.

   With respect to the above, which of the following is correct?

   (A) Ima, invention and innovation are unrelated to the ability to construct mental world

   (B) We do not know any species than humans who possess ability to construct mental world

   (C) Ima…, Invention…, and innovation refers to unrelated skills

   (D) No species possess ability to construct mental world.

   [Ans. *]

5. Let $\lambda(p, q) = \begin{cases} (p - q)^2 \text{ if } p \geq q \\ p + q \text{ if } p < q \end{cases}$

   Then $\dfrac{\lambda\big(-(-3+2), (-2+3)\big)}{\big(-(-2+1)\big)}$ will be

   (A) 16/3

   (B) 16

   (C) 0
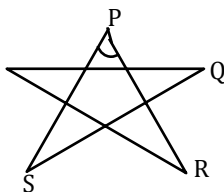
   (D) -1

   [Ans. *]

6. What will be the mirror image of the following word if mirror is kept among along x-axis?
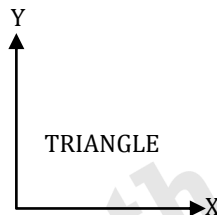
   (A)
   (B)
   (C)
   (D)
   [Ans. *]

7. Following shape is forward by S equal length segments PR, PS, TQ, TR, and QS. what will be the angle θ ?

   [Ans. *]36

8. In a company ,35% employees drink coffee, 40%. Drink tea and 10% .drink both tea and coffee .Then how much percentage of employees will neither drink coffee nor tea ?
   (A) 40%
   (B) 15%
   (C) 25%
   (D) 35%
   [Ans. D]

9. For persons P, Q, R, S are to be seated in a row facing same direction. P and R cannot be seated adjacent .S should be seated right of Q. Then how many distinct seating arrangement is possible?
   (A) 6
   (B) 8
   (C) 2
   (D) 4
   [Ans. A]

10. A

Technical

Q.1 - Q.25 Carry One Mark each.

1. Taking N as positive for CW encirclement the number of N of $(-1, 0)$ in the Nyquist plot of $G(s) = \frac{3}{s-1}$ is _____.

2. An infinity long line with uniform positive charge density lies along Z-axis. In cylindrical co-ordinates (r, ϕ, z) at any point $\vec{P}$ not an Z-axis. The direction of electric field is

    (A) $\frac{\hat{r} + \hat{z}}{Z}$

    (B) $\hat{Z}$

    (C) $\hat{r}$

    (D) $\hat{\phi}$

3. Consider the Analog circuit shown below where diode has voltage drop of 0.6V. When it gets forward biased; the value of V_A is _____ Volt.
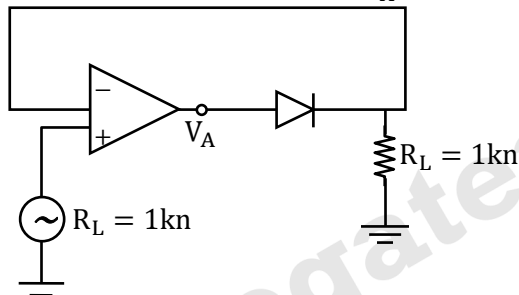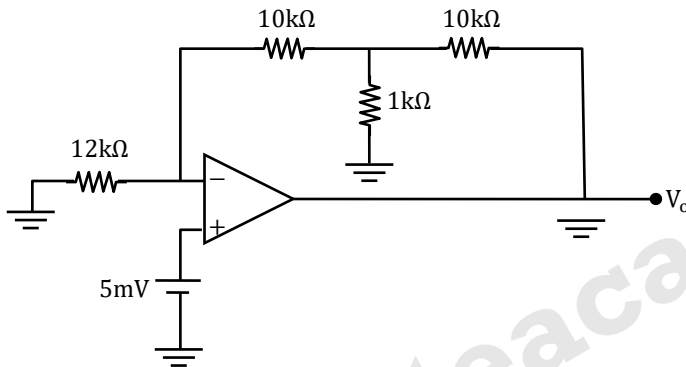

4. Consider the Analog circuit shown below, Where $\beta = 99$ for Q_1 and Q_2 the value of I_B_____mA
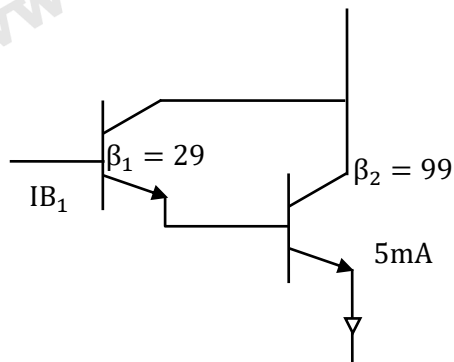
5. Consider the Analog circuit shown below Where $V_o = 5V$ Assume that opamp is ideal then value of $R_L - K\Omega$
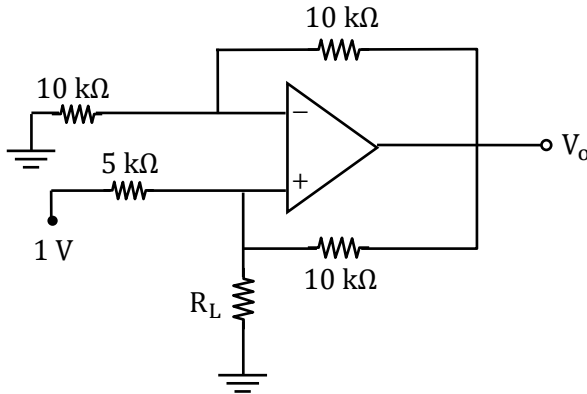

6. Output V_0 is _____ volt.

7. An AM scheme uses tone modulation with modulation index of 0.6. The power efficiency of AM scheme is _____ % (up to 1 decimal place)

8. A household fan consumer 60w & draws a current of 0.3125 A (rms) when connected to a 230 V (rms) ac, 50Hz single phase mains. The reactive force drawn by the fan is _____ VAR (round off nearest integer)

9. In the bridge cut shown, Voltmeter V showed o when value of register $R_1 = 100\Omega$, $R_2 = 110\Omega$, $R_3 = 90\Omega$ if $\frac{R_1}{R_2} = \frac{RA}{RB}$ then the value of R4 (in ohms is_____).
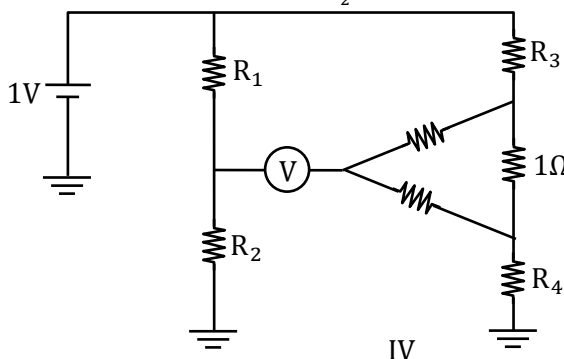
10. A household fan consumes 60 W and draws a current of 0.3125 A when connected to a 230 V rms ac, 50 Hz, single phase mains. Reactive power drawn by the fan in VAR is _____.

11. In Michelson interferometer, when arm is moved by 300µm, then number of fringes are displaced by 1200 then the wavelength of monochromatic light is _____ nm.

12. Consider the circuit shown below, where time is taken by detector to get through air to water and water to air 100 ns, Refractive index of water $(n_{water}) = 1.3$, speed of light is 3×10^8 m/sec, the value of xm_____ meter
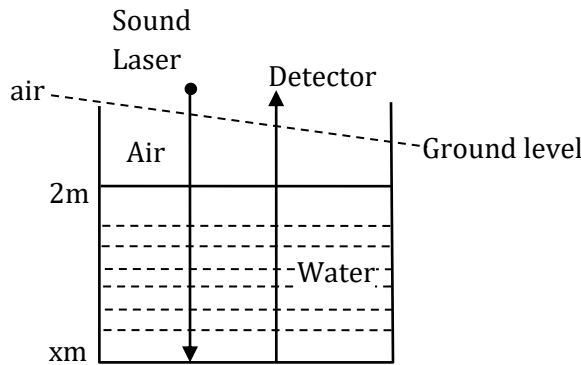
13. Consider the circuit shown below, when LED light will incident on object having radius 1 cm, determine the refractive index of liquid _____ (Assume $n_{core} = 1.5, n_{cladding} = 1.2$)
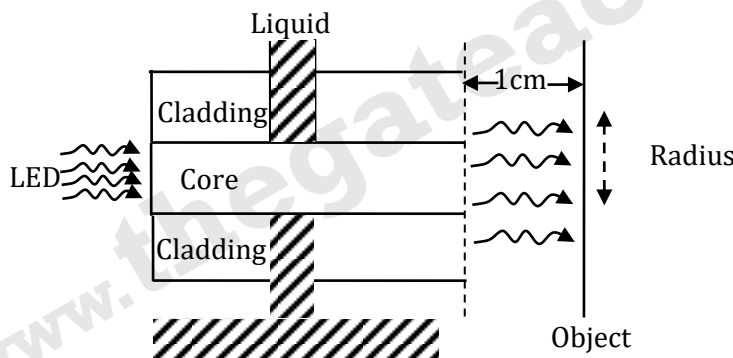
14. $f(z) = (z-1)^{-1} - 1 + (z-1) - (z-1)^2 + \ldots$ is the series expansion of

(A) $\dfrac{1}{(z-1)^2}$ for $|z-1| < 1$

(B) $\dfrac{1}{z(z-1)}$ for $|z-1| < 1$

(C) $\dfrac{-1}{Z-1}$ for $|z-1| < 1$

(D) $\dfrac{-1}{(z)(z-1)}$ for $|z-1| < 1$

[Ans. *]

15. Let $f(z) = \dfrac{1}{z^2 + 6z + 9}$, defined in complex plane. This intergal $\oint_c F(z)$ over the contour of c circle C with center at the origin and unit radius is _____.
[Ans. *]

16. If $M = \begin{bmatrix} 1 & 2 & 0 & 0 \\ 2 & 4 & 0 & 0 \\ 0 & 0 & 4 & 3 \\ 0 & 0 & 2 & 1 \end{bmatrix}$ then $|M| = $ _____
[Ans. *]

17. If $f(z) = -x^2 + 10x + 100$, the minimum of f(x) in interval [5, 10] is _____
[Ans. *]

18. $x_n = 0.5 \, x_{n-1} + 1, n = 1, 2, \dots$ with $x_o = 0$, then $\underset{n \to \infty}{lt} \, x_n$ is _____
(A) 10
(B) 1
(C) ∞
(D) 2
[Ans. *]

19. $V = [1 \; 0] \; w = [2 \; 0]$
Rank of $M = 2V^T V + 3 \, W^T W$ is _____
(A) 12
(B) 3
(C) 4
(D) 1
[Ans. D]

20. Given $A = \begin{bmatrix} 2 & 5 \\ 0 & 3 \end{bmatrix}$, then $|A^4 - 5A^3 + 6A^2 + 2I| = $ _____
[Ans. *]

21. x and y independent continuous random variables $x \sim (2, 3), y \sim (1, 4)$
$P(y \leq x):$ _____
[Ans. *]

22. A signal having bandwidth of 5MHz is transited . using PCM. As follows: Signal is sampled at 50% above Nyquist rate and quantized into 256 bids. Binary pulse rate of PCM is _____ Mbps.
[Ans. *]
120 Mbps

23. AM scheme with modulation index of 0.6. The power efficiency of AM scheme is _____%
[Ans. *]
15.25%

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24. Draw a 4×1 mux diagram and the inputs are

$I_0 = \overline{Z} + w$ $S_1 = X$
$I_1 = 0$ $S_2 = Y$
$I_2 = Z\,W$
$I_3 = Z\,\overline{W}$ Output is F.

(A) $F(X, Y, Z, W) = \sum m(1, 3, 7, 9)$
(B) $F(X, Y, Z, W) = \sum m(2, 5, 9, 11, 14)$
(C) $F(X, Y, Z, W) = \sum m(0, 1, 3, 11, 14)$
(D) $F(X, Y, Z, W) = \sum m(0, 1, 3, 14, 15)$

25. A 10 bit ADC has a full scale voltage of 10.23 V, when the digital o/p is $(11\ 1111\ 1111)_2$ Quantization error of ADC in mv_____ ?

26. A 16-bit microprocessor has 20 address liner (A_0 to A_{19}) and 16 data liner. Higher 8 data liner are tied to the 8 data liner of 16 KB memory that can store one byte in each, of its 16k address locations. Memory chip should map on to contiguous memory location and occupy only 16 KB mom space.

(A) Active high chip select needed to map 16 KB memory with the starting at F0000H is given by logical expression $A_{19}\,A_{18}\,A_{17}\,A_{16}$

(B) The above chop can't be interfaced as width of database of processor & memory chip differs.

(C) 16 KB memory can't be mapped. With contiguous address location with starting address as 0F000H using only A_{19} to A_{14} for generating chip select

(D) If 16 KB memory chip is mapped with a starting address 80000H then the ending address will be 83FFFH

27. 4×1 multiplexer with two selection line is used to realize Boolean function F having four Boolean variable x, y, z, w as shown, S_0, S_1 denotes the LSB and MSB of selection lines of multiplexer. I_0, I_1, I_2, I_3 are input line. The canonical sum of product of F is
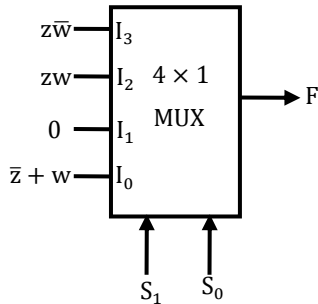
(A) $F(x, y, z, w) = \sum m(2, 5, 9, 11, 14)$
(B) $F(x, y, z, w) = \sum m(0, 1, 3, 14, 15)$
(C) $F(s, y, z, w) = \sum m(0, 1, 3, 11, 14)$

28. Given block diagram of synchronous sequential circuit with one JK-flip-flop and one T-flip-flop With their output denoted as A and B respectively with J)$A = \overline{(A + \overline{B})}, K_A = (A + B)$ and $T_B = A$, starting from the initial state $AB = 00$, the sequence of states AB visited by the circuit.
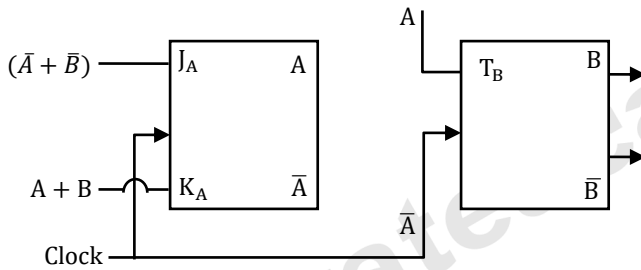

(A) $00 \to 10 \to 11 \to 01 \to 00 \dots$
(B) $00 \to 01 \to 10 \to 11 \to 00 \dots$
(C) $00 \to 10 \to 01 \to 11 \to 00 \dots$

29. $J_A = \overline{A} + \overline{B}, \ KA = A + B, \ T_B = A$ Synchronous Sequential ckts with initial state $AB = 00$. Then sequence of state (AB) of the ckt ae_____
(A) $00 \to 10 \to 11 \to 01 \to 00$
(B) $00 \to 10 \to 01 \to 11 \to 00$
(C) $00 \to 01 \to 11 \to 00$ ___
(D) $00 \to 01 \to 10 \to 11 \to 00$ ___

30. A 4-bit flash type ABC having a full-scale input voltage range 'V', choose the correct statement among the following.
(A) A 4-bit flash type ABC require 15 comparators.
(B) It requires a 4 to 2 priority encoder and 4 comparators.
(C) Change in i/p voltage by V/16 will always flip MSB of o/p.
(D) Change in i/p voltage by V/16 will always lip LSB of o/p.

31. $F(X, Y, Z) = (\overline{X} + Y + Z)(X + \overline{Y} + Z)(\overline{X} + Y + \overline{Z})(\overline{X}\,\overline{Y}\,\overline{Z} + \overline{X}\,Y\,\overline{Z} + X\,Y\,\overline{Z})$

(A) $F(X, Y, Z) = \overline{X}\,\overline{Z} + Y\,\overline{Z}$

(B) $F(X, Y, Z) = (X + Y + \overline{Z})(\overline{X} + \overline{Y} + \overline{Z})$

(C) $F(X, Y, Z) = (\overline{X} + Y)(X + \overline{Y} + \overline{Z})$

(D) $F(X, Y, Z) = (\overline{X}\,\overline{Y}Z + X\,Y\,Z)$

32. A household fan consumes 60 watt and draw a current of 0.3125 A (rms) when connected to a 230 V (rms) AC, 50 Hz single phase moving. The reactive power drawn by the fan is _____ VAR (round off nearest integer)

33. Taking N as positive for CW encirclement the number of N of $(-1, 0)$ in the Nyquist plot of $G(s) = \frac{3}{s-1}$ is _____.

34. Input $x(t) = \sqrt{2}\sin t\, u(t)$ is provided to a system having transfer function $G(s) = \frac{1}{s+1}$.

The steady state output is _____

[Ans. *]

35. Consider a unity feedback configuration with a plant and a PID controller shown in figure

$G(s) = \dfrac{1}{(s + 1)(s + 3)}$ and $C(s) = \dfrac{k(s + 3 - j)(s + 3 + j)}{s}$

With k being scalar. The closed loop is
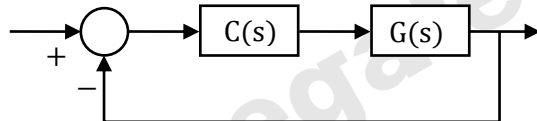
(A) Only stable for $k > 0$

(B) Only stable for k between -1 and $+1$

(C) Stable for all values of k

(D) Only stable for $k < 0$

[Ans. *]

36. Let $u(t)$ is the step funtion. The bilateral Laplace Transform of $f(t) = e^t u(-t)$ is _____

(A) $\dfrac{1}{s - 1}, \sigma > 1$

(B) $\dfrac{-1}{s - 1}, \sigma < 1$

(C) $\dfrac{1}{s - 1}, \sigma < 1$

(D) $\dfrac{-1}{s - 1}, \sigma > 1$

[Ans. B]

37. The step response of a circuit is seen to have an oscillating behaviour at the output with oscillations dying down after some time. The correct inference regarding the transfer function from input to output is/are
(A) That it has at least are pair that is un-damped
(B) That it is a first order system
(C) That it is of at least second order
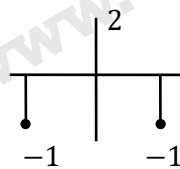(D) That it does not have a real pole
[Ans. A, C]

38. The input $x(t) = \sqrt{2}\sin t\, u(t)$ is given as input to an LTI system with transfer function $G(s) = \dfrac{1}{s+1}$. The steade state output is _____
[Ans. *] Range: 1 to 1

39. The signal $\sin\sqrt{2\pi t}$ is
(A) Non periodic
(B) Periodic with $T = 4\pi^2$
(C) Periodic with $T = \sqrt{2\pi}$
(D) Periodic with $T = 2\pi$
[Ans. *]

40.

Input
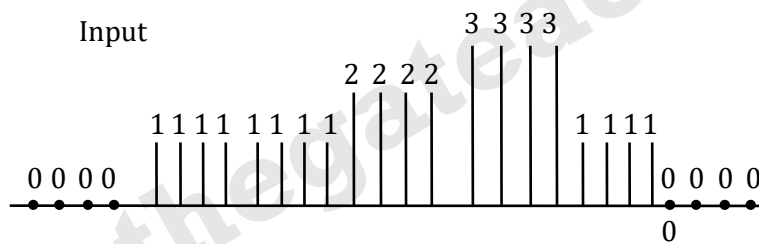
is passed through filter with following taps

The number of non-zero output samples is _____.
[Ans. *] Range: 10 to 10

41. An air cored coil having a winding resistance of 10Ω is connected in series with 9 variable capacitors C_x. Series circuit is excited by 10V sinusoidal Voltage source of angular frequency 1000 rad/sec. As the value of capacitances varied, a node voltage of 30V was obtained across it. Neglecting skin effect, Value of inductance of coil in mH is_____.
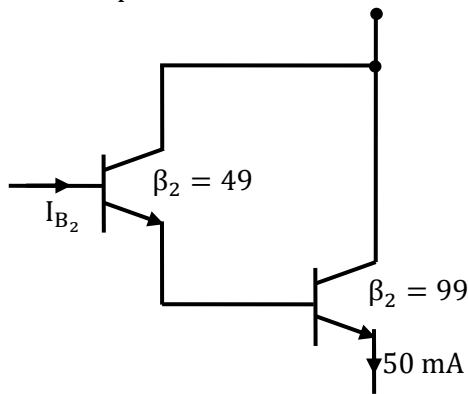
41. The transistor Q_1 has current gain $\beta_1 = 99$ and Q_2 has $\beta_2 = 49$, the current I_{B_2} in microampere is _____.

I_{B_2}

$\beta_2 = 49$

$\beta_2 = 99$

50 mA

42. Consider the sequence $x_n = 0.5\, x_{n-1} + 1, n = 1, 2, 3, \ldots$ if $x_o = 0$ then the value of $\lim\limits_{n \to \infty} x_n$ is

(A) ∞
(B) 0
(C) 2
(D) 1

Coming Soon

43. A

44. A

45. A

46. A

47. A

48. A

49. A

50. A