GATE-2015

Question Paper

&

Answer Keys

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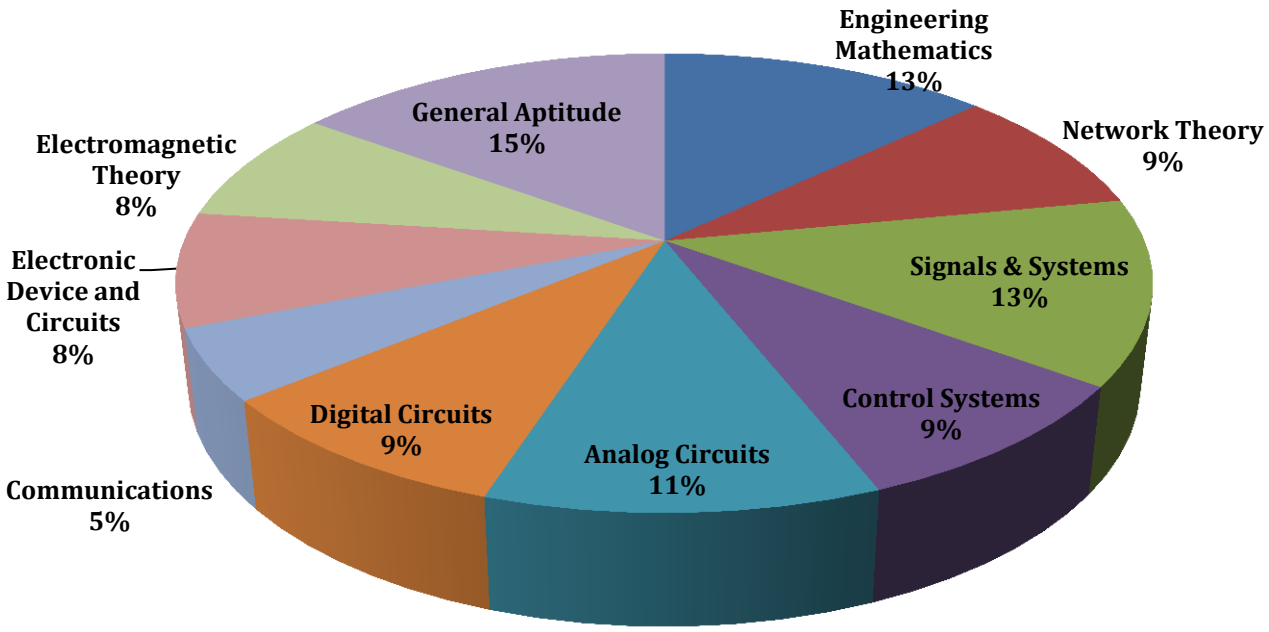
ANALYSIS OF GATE 2015 SET-2
Electronics and Communication Engineering



GATE-2015-ECE-SET-2

SUBJECT	NO OF QUESTION	Topics Asked in Paper	Total Marks
Engineering Mathematics	1M:3 2M:5	Linear Algebra Probability and Distribution Calculus, Differential Equation	13
Network Theory	1M:3 2M:3	Network Solution and methodology Transient /Study State Analysis of RLC Circuit to DC input , Sinusoidal study state Analysis Laplace transforms, Two –port Network	9
Signals & Systems	1M:5 2M:4	Linear Time invariant (LTI)System Samples, Fourier Representation of signal Z-Transform, Laplace Transform	13
Control Systems	1M:3 2M:3	Basic of Control System, Time domain Analysis Frequency response Analysis using bode plot State Variable Analysis	9
Analog Circuits	1M:3 2M:4	Diode –Circuit –Analysis &Application Small Signal Modeling of BJT & FET Operational Amplifier and Its Application	11
Digital Circuits	1M:3 2M:3	Boolean Algebra &K Map Combinational Digital Circuit Sequential Digital Circuit & Counter Introduction to Microprocessor	9
Communications	1M:1 2M:2	Noise Angle modulation Digital Communication	5
Electronic Device and Circuits	1M:2 2M:3	Semiconductor theory P-n Junction Theory R Characteristics FET(JEFT,MOSFET,)& CMOS	8
Electromagnetic Theory	1M:2 2M:3	Electronics & Magnetic Field Electromagnetic Waves, Guided Waves Antennas, Guided Waves	8
General Aptitude	1M:5 2M:5	Numerical Ability Verbal Ability	15
Total	**65**		**100**

GATE 2015 Examination

Electronics and Communication Engineering

Test Date: 31/01/2015

Test Time: 2:00 PM 5:00 PM

Subject Name: EC ELECTRONICS AND COMMUNICATION ENGINEERING

Section: General Aptitude

1. Ram and Ramesh appeared in an interview for two vacancies in the same department. The probability of Ram's selection is 1/6 and that of Ramesh is 1/8. What is the probability that only one of them will be selected?

(A) 47/48
(C) 13/48
(B) 1/4
(D) 35/48

[Ans. B]

2. Choose the appropriate word/phrase. out of the four options given below, to complete the following sentence:

Dhoni, as well as the other team members of Indian team _____present on the occasion.

(A) Were
(C) Has
(B) Was
(D) Have

[Ans. B]

3. An electric bus has onboard instruments that report the total electricity consumed since the start of the trip as well as the total distance covered. During a single day of operation, the bus travels on stretches M. N. O. and P. in that order. The cumulative distances travelled and the corresponding electricity consumption are shown in the Table below:

Stretch	Cumulative distance (km)	Electricity used (kWh)
M	20	12
N	45	25
O	75	45
P	100	57

The stretch where the electricity consumption per km is minimum is

(A) M
(C) O
(B) N
(D) P

[Ans. D]

4. Choose the word most similar in meaning to the given word:

Awkward

(A) Inept
(C) Suitable
(B) Graceful
(D) Dreadful

[Ans. A]

5. What is the adverb for the given word below?
Misogynous
(A) Misogynousness
(B) Misogynity
(C) Misogynously
(D) Misogynous
[Ans. C]

6. Given below are two statements followed by two conclusions. Assuming these statements to be true, decide which one logically follows.
Statements:
I. All film stars are playback singers
II. All film directors are film stars.
Conclusions:
I. All film directors are playback singers.
II. Some film stars are film directors.
(A) Only conclusion I follows.
(B) Only conclusion II follows.
(C) Neither conclusion I nor II follows.
(D) Both conclusions I and II follow.
[Ans. D]

7. In the following sentence certain parts are underlined and marked P, Q and R. One of the parts may contain certain error or may not be acceptable in standard written communication. Select the part containing an error. Choose D as your answer if there is no error.
The student corrected <u>all the errors</u> that <u>the instructor marked</u> on the <u>answer book</u>.
P Q R
(A) P
(B) Q
(C) R
(D) No Error
[Ans. B]

8. If $a^2 + b^2 + c^2 = 1$. Then ab+ bc + ac lie in the interval
(A) $[1, 2/3]$
(B) $[-1/2,1]$
(C) $[-1, 1/2]$
(D) $[2, -4]$
[Ans. B]

9. A tiger is 50 leaps of its own behind a deer. The tiger takes 5 leaps pel minute to the deer's 4. If the tiger and the deer cover 8 metre and 5 metre per leap respectively, what distance in metres will the tiger have to run before it catches the deer?
[Ans. *] Range: 800 to 800

10. Lamenting the gradual sidelining of the arts in school curricula. a group of prominent artists wrote to the Chief Minister last year, asking him to allocate more funds to support arts education in schools. However, no such increase has been announced in this year's

Budget. The artists expressed their deep anguish at their request not being approved, but many of them remain optimistic about funding in the future.
Which of the statement(s) below is/are logically valid and can be inferred from the above statements?

(i) The artists expected funding for the arts to increase this year
(ii) The Chief Minister was receptive to the idea of increasing funding for the arts.
(iii) The Chief Minister is a prominent artist.
(iv) Schools are giving less importance to arts education nowadays.

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

[Ans. B]

Section: Electronics and Communication Engineering

1. A unity negative feedback system has an open-loop transfer function $G(s) = \frac{K}{s(s+10)}$ .The gain K for the system to have a damping ratio of 0.25 is_____.

[Ans. *] Range: 400 to 400

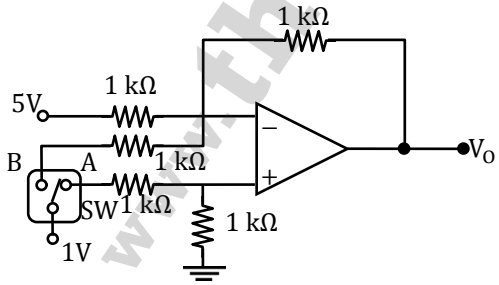
2. An n-type silicon sample is uniformly illuminated with light which generates 10^{20} electron-hole pairs per cur per second. The minority earner lifetime m the sample is 1 μs In the steady state, the hole concentration in the sample is approximately 10^x, where x is an integer. The value of x is _____.

[Ans. *] Range: 14 to 14

3. In a source free region in vacuum, if the electrostatic potential $\varphi = 2x^2 + y^2 + cz^2$. the value of constant c must be _____.

[Ans. *] Range: -3 to -3

4. In the circuit shown, $V_O = V_{0A}$ for switch SW in position A and $V_0 = V_{0B}$ for SW in position B. Assume that the op-amp is ideal The value of $\frac{V_{0B}}{V_{0a}}$ is _____

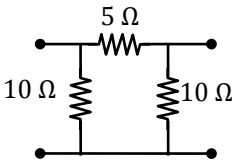


[Ans. *] Range: 1.5 to 1.5

5. Two causal discrete time signals x[n] and y[n] are related as $y[n] = \sum_{m=0}^{n} x[m]$. If the z-transform of y[n]is $\frac{2}{z(z-1)^2}$, the value of x[2] is _____

[Ans. *] Range: 0 to 0

6. The 2-port admittance matrix of the circuit shown is given by



(A) $\begin{bmatrix}0.3 & 0.2\\0.2 & 0.3\end{bmatrix}$

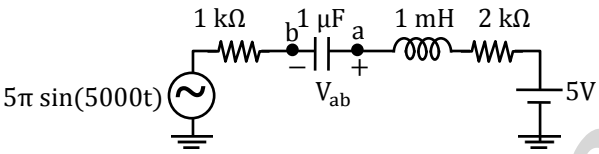
(B) $\begin{bmatrix}15 & 5\\5 & 15\end{bmatrix}$

(C) $\begin{bmatrix}3.33 & 5\\5 & 3.33\end{bmatrix}$

(D) $\begin{bmatrix}0.3 & 0.4\\0.4 & 0.3\end{bmatrix}$

[Ans. A]

7. In the circuit shown, the average value of the voltage V_{ab} (in Volts) in steady state condition is _____



[Ans. *] Range: 5 to 5

8. By performing cascading and/or summing/differencing operations using transfer function blocks $G_1(s)$ and $G_2(s)$, one CANNOT realizes transfer function of the form

(A) $G_1(s)G_2(s)$

(B) $\dfrac{G_1(s)}{G_2(s)}$

(C) $G_1(s)\left(\dfrac{1}{G_1(s)}+G_2(s)\right)$

(D) $G_1(s)\left(\dfrac{1}{G_1(s)}-G_2(s)\right)$

[Ans. B]

9. The general solution of the differential equation $\frac{dy}{dx}=\frac{1+\cos 2y}{1-\cos 2x}$ is

(A) $\tan y-\cot x=c$(c is a constant)

(B) $\text{tau } x-\cot y=c$(c is a constant)

(C) $\tan y+\cot x=c$(c is a constant)

(D) $\tan y+\cot x=c$(c is a constant)

[Ans. C]

10. The signal $\cos\left(10\,\pi t+\frac{\pi}{4}\right)$ is ideally sampled at a sampling frequency of 15 Hz. The sampled signal is passed through a filter impulse response $\left(\frac{\sin(\pi t)}{\pi t}\right)\cos\left(40\pi t-\frac{\pi}{2}\right)$. The filter output is

(A) $\dfrac{15}{2}\cos\left(40\pi t-\dfrac{\pi}{4}\right)$

(B) $\dfrac{15}{2}\left(\dfrac{\sin(\pi t)}{\pi t}\right)\cos\left(10\pi t+\dfrac{\pi}{4}\right)$

(C) $\dfrac{15}{2}\cos\left(10\pi t-\dfrac{\pi}{4}\right)$

(D) $\dfrac{15}{2}\left(\dfrac{\sin(\pi t)}{\pi t}\right)\cos\left(40\pi t-\dfrac{\pi}{4}\right)$

[Ans. A]

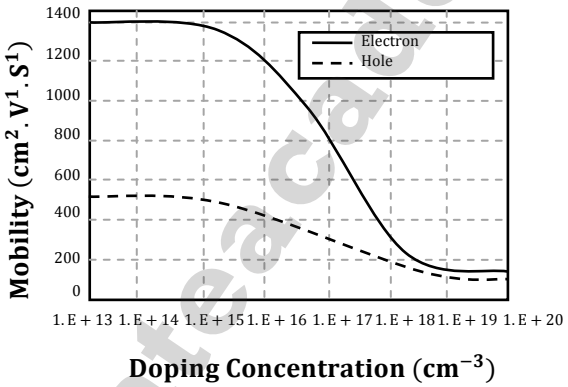
11. Let the signal f(t) = 0 outside me interval $[T_1, T_2]$ where T_1 and T_2 are finite. Furthermore, $|f(t)| < \infty$ The region of convergence (ROC) of the signal s bilateral Laplace transfonn F(s) is

(A) a parallel strip containing the jΩ axis
(B) a parallel strip not containing the jΩ axis
(C) the entire s-plane
(D) a half plane containing the jΩ axis

[Ans. C]

12. A piece of silicon is doped uniformly with phosphorous with a doping concentration of $10^{16}/cm^3$. The expected value of mobility versus doping concentration for silicon assuming full dopant ionizatiou is shown below. The charge of an electron is 1.6×10^{-19} C. The conductivity (in S cm^{-1}) of the silicon sample at 300 K is_____.

Hole and Electron Mobility in Silicon at 300 k



[Ans. *] Range: 1.92 to 1.92

13. The value of x for which all the eigen-values of the matrix given below are real is

$$\begin{bmatrix} 10 & 5+j & 4 \\ x & 20 & 2 \\ 4 & 2 & -10 \end{bmatrix}$$

(A) $5 + j$
(B) $5 - j$
(C) $1 - 5j$
(D) $1 + 5j$

[Ans. A]

14. The electric field of a uniform plane electromagnetic wave is

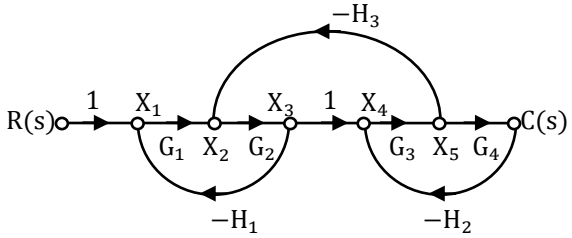
$\vec{E} = (\vec{a}_x + j4\vec{a}_y) \exp[j(2\pi \times 10^7 t - 0.2z)]$

The polarization of the wave is

(A) right handed circular
(B) right handed elliptical
(C) left handed circular
(D) left handed elliptical

[Ans. D]

15. For the signal flow graph shown in the figure, the value of $\frac{C(s)}{R(s)}$ is



(A) $\frac{G_1G_2G_3G_4}{1-G_1G_2H_1-G_3G_4H_2-G_2G_3H_3+G_1G_2G_3G_4H_1H_2}$

(B) $\frac{G_1G_2G_3G_4}{1+G_1G_2H_1+G_3G_4H_2+G_2G_3H_3+G_1G_2G_3G_4H_1H_2}$

(C) $\frac{1}{1+G_1G_2H_1+G_3G_4H_2+G_2G_3H_3+G_1G_2G_3G_4H_1H_2}$

(D) $\frac{1}{1-G_1G_2H_1+G_3G_4H_2+G_2G_3H_3+G_1G_2G_3G_4H_1H_2}$

[Ans. B]

16. The bilateral Laplace transform of a function $f(t)=\begin{cases}1 & \text{if } a\le t\le b\\ 0 & \text{otherwise}\end{cases}$ is

(A) $\frac{a-b}{s}$

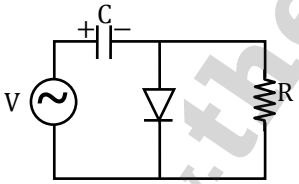
(B) $\frac{e^s(a-b)}{s}$

(C) $\frac{e^{-as}-e^{-bs}}{s}$

(D) $\frac{e^{s(a-b)}}{s}$

[Ans. C]

17. If the circuit shown has to function as a clamping circuit, then which one of the following conditions should be satisfied for the sinusoidal signal of period T?



(A) $RC \ll T$

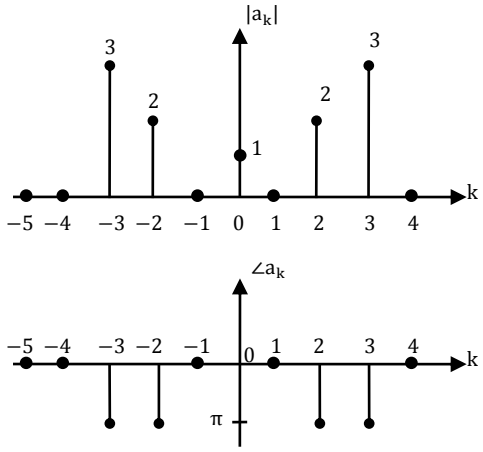
(B) $RC = 0.35T$

(C) $RC \approx T$

(D) $RC \gg T$

[Ans. D]

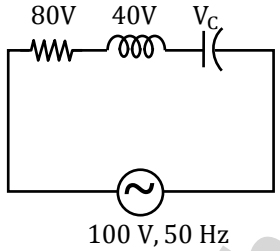
18. The magnitude and phase of the complex Fourier series coefficients ak of a periodic signal x(t) are shown in the figure. Choose the correct statement from the four choices given. Notation: C is the set of complex numbers, R is the set of purely real numbers, and P is the set of purely imaginary numbers.



(A) $x(t) \in R$
(B) $x(t) \in P$
(C) $x(t) \in (C - R)$
(D) the information given is not sufficient to draw any conclusion about x(t)
[Ans. C]

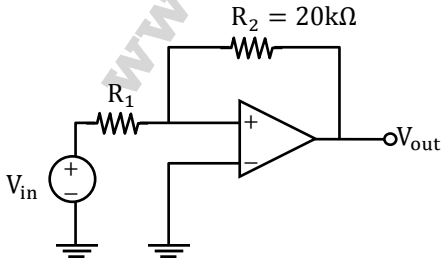
19. Let $f(z) = \frac{az+b}{cz+d}$. If $f(z_1) = f(z_2)$ for all $z_1 \neq z_2, a = 2, b = 4$ and $c = 5$, then d should be equal to _____
[Ans. *] Range: 10 to 10

20. The voltage (V_c) across the capacitor (in Volts) in the network shown is_____.



[Ans. *] Range: 100 to 100

21. In the bistable circuit shown, the ideal Op-Amp has saturation levels of $\pm$ 5 V. The value of R_1 (in kΩ) that gives a hysteresis width of 500 mV is_____

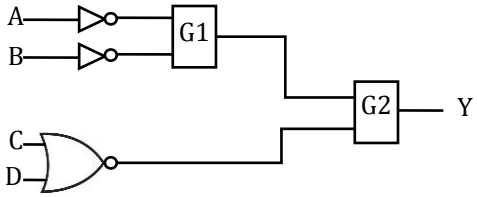


[Ans. *] Range: 1 to 1

22. A sinusoidal signal of amplitude A is quantized by a uniform quantizer. Assume that the signal utilizes all the representation levels of the quantizer. If the signal to quantization noise ratio is 31.8 dB. the number of levels m the quantizer is _____

[Ans. *] Range: 32 to 32

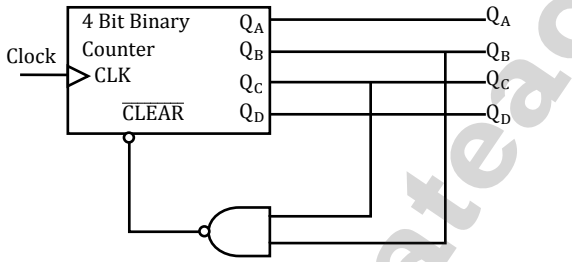
23. In the figure shown, the output Y is required to be $Y = A\,B + \bar{C}\,\bar{D}$. The gates G1 and G2 must be, respectively.



(A) NOR, OR
(B) OR, NAND
(C) NAND, OR
(D) AND, NAND

[Ans. A]

24. A mod-n counter using a synchronous binary up-counter with synchronous clear input is shown in the figure. The value of n is_____



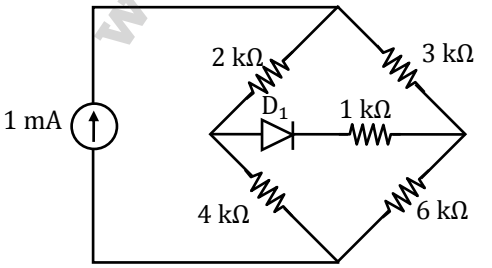
[Ans. *] Range: 6 to 6

25. In an 8085 microprocessor, which one of the following instructions changes the content of the accumulator?

(A) MOV B, M
(B) PCHL
(C) RNZ
(D) SBI BEH

[Ans. D]

26. The diode in the circuit given below has V_{ON}= 0.7 V but is ideal otherwise. The current (in mA) in the 4 kΩ resistor is _____



[Ans. *] Range: 0.6 to 0.6

27. The transfer function of a mass-spring-damper system is given by

$$G(s) = \frac{1}{Ms^2 + Bs + K}$$

The frequency response data for the system are given in the following table.

ω in rad/s	|G(jω)| in dB	arg G(jω)) in deg
0.01	−18.5	−0.2
0.1	−18.5	−1.3
0.2	−18.4	−2.6
1	−16	−16.9
2	−11.4	−89.4
3	−21.5	−151
5	−32.8	−167
10	−45.3	−174.5

The unit step response of the system approaches a steady state value of _____

[Ans. *] Range: 0.4 to 0.4

28. Input x(t) and output y(t) of an LTI system are related differential equation $y''(t) - y'(t) - 6y(t) = x(t)$. If the system is neither causal nor stable, the impulse response h(t) of the system is

(A) $\frac{1}{5}e^{3t}\,u(-t) + \frac{1}{5}e^{-2t}u(-t)$

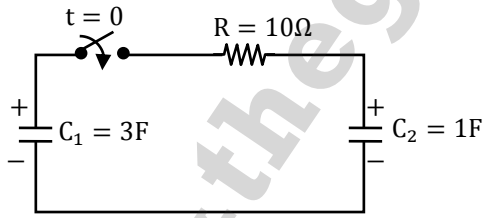
(B) $-\frac{1}{5}e^{3t}\,u(-t) + \frac{1}{5}e^{-2t}u(-t)$

(C) $\frac{1}{5}e^{3t}\,u(-t) - \frac{1}{5}e^{-2t}u(t)$

(D) $-\frac{1}{5}e^{3t}\,u(-t) - \frac{1}{5}e^{-2t}u(-t)$

[Ans. B]

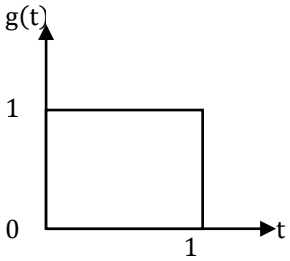
29. In the circuit shown, the initial voltages across the capacitors C_1 and C_2 are 1V and 3V. respectively. The switch is closed at time t = 0. The total energy dissipated (m Joules) in the resistor R until steady state is reached, is _____



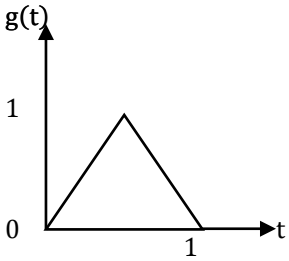
[Ans. *] Range: 1.5 to 1.5

30. Consider a binary, digital communication system which uses pulses g(t) and −g(t) for transmitting bits over an AWGN channel. If the receiver uses a matched filter, which one of the following pulses will give the minimum probability of bit error?

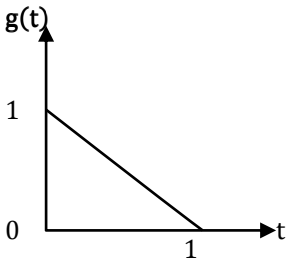
(A)



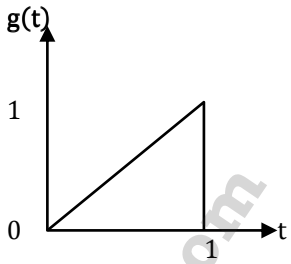
(B)



(C)

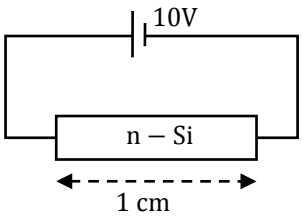


(D)



[Ans. A]

31. A dc voltage of 10 V is applied across an n-type silicon bar having a rectangular cross-section and a length of 1 cm as shown in figure. The donor doping concentration N_D and the mobility of electrons μ_n are $10^{16}cm^{-3}$ and 1000 $cm^2V^1S^{-1}$. respectively. The average time (in μs) taken by the electrons to move from one end of the bar to other end is _____



[Ans. *] Range: 100 to 100

32. The electric field of a plane wave propagating in a lossless non-magnetic medium is given by the following expression

$$E(z,t) = a_x 5\cos(2\pi \times 10^9 t + \beta z) + a_y 3\cos\left(2\pi \times 10^9 t + \beta z - \frac{\pi}{2}\right)$$

The type of the polarization is

(A) Right Hand Circular.
(B) Left Hand Elliptical.
(C) Right Hand Elliptical.
(D) Linear.

[Ans. B]

33. An LC tank circuit consists of an ideal capacitor C connected m parallel with a coil of inductance L having an internal resistance R . The resonant frequency of the tank circuit is

(A) $\frac{1}{2\pi\sqrt{LC}}$

(B) $\frac{1}{2\pi\sqrt{LC}}\sqrt{1 - R^2\frac{C}{L}}$

(C) $\frac{1}{2\pi\sqrt{LC}}\sqrt{1 - \frac{L}{R^2C}}$

(D) $\frac{1}{2\pi\sqrt{LC}}\left(1 - \frac{R^2C}{L}\right)$

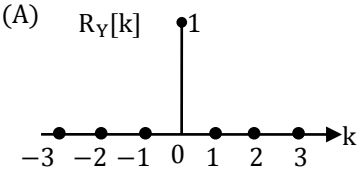
[Ans. B]

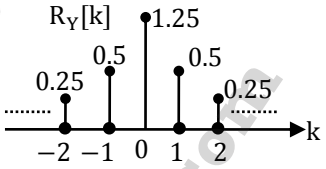
34. Let $X \in (0,1\}$and $Y \in \{0,1\}$be two independent binary random variables. If $P(X = 0) = p$ and $P(Y = 0) = q$. then $P(X + Y \geq 1)$ is equal to

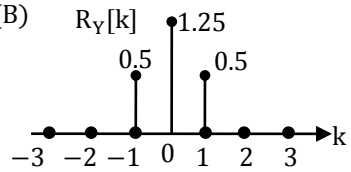
(A) $pq + (1-p)(1-q)$
(B) pq
(C) $p(1-q)$
(D) $1 - pq$

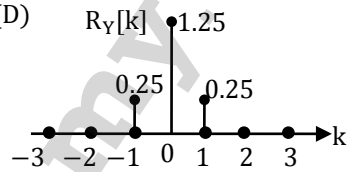
[Ans. D]

35. $\{X_n\}_{n=-\infty}^{n=\infty}$ is an independent and identically distributed (i.i.d) random process with X_n equally likely to be +1 or –1. $\{Y_n\}_{n=-\infty}^{n=\infty}$ is another random process obtained as $Y_n = X_n + 0.5X_{n-1}$. The autocorrelation function of $\{Y_n\}_{n=-\infty}^{n=\infty}$, denoted by $R_y[k]$, is

(A)


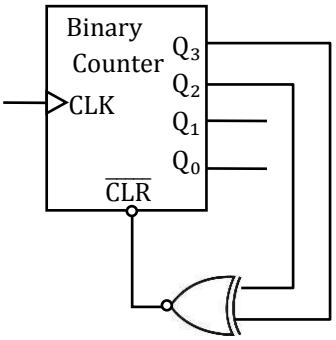
(C)


(B)


(D)


[Ans. C]

36. The figure shows a binary counter with synchronous clear input. With the decoding logic shown. the counter works as a



(A) mod-2 counter
(B) mod-4 counter
(C) mod-5 counter
(D) mod-6 counter

[Ans. B]

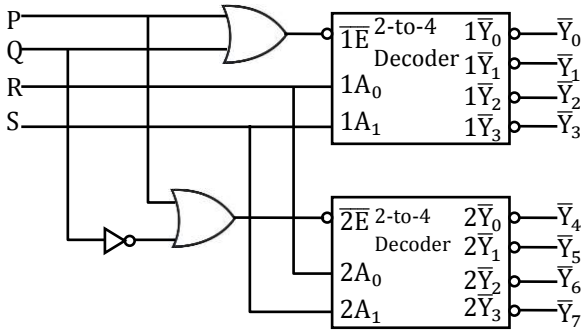
37. Consider the differential equation $\frac{dx}{dt} = 10 - 0.2x$ with initial condition x(0)=1.
The response x(t) for t > 0 is

(A) $2 - e^{-0.2t}$
(B) $2 - e^{0.2t}$
(C) $50 - 49e^{-0.2t}$
(D) $50 - 49e^{0.2t}$

[Ans. C]

38. Consider two real sequences with tune-origin marked by the bold value,
$x_1[n] = \{1, 2, 3, 0\}$. $x_2[n] = \{1,3,2,1\}$
Let $X_1(k)$and $X_2(k)$be 4-point DFTs of $x_1[n]$ and $x_2[n]$ respectively.
Another sequence $x_3[n]$ is derived by taking 4-point inverse DFT of $X_3(k) = X_1(k)X_2(k)$
The value of $x_3[2]$ is
[Ans. *] Range: 11 to 11

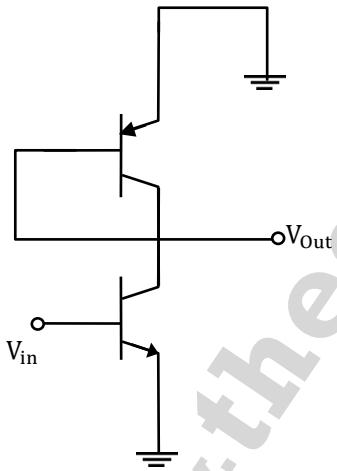
39. A 1-to-8 demultiplexer with data input D_{in}, address inputs So. S_1, S_2 (with So as the LSB) and $\overline{Y}_0$ to $\overline{Y}_7$ as the eight demultiplexed outputs, is to be designed using two 2-to-4 decoders (with enable input $\overline{E}$ and address inputs A_0 and A_1) as shown in the figure. D_{in}, S_0, S_1 and S_2 are to be connected to P. Q, R and S, but not necessarily in this order. The respective input connections to P, Q, R, and S terminals should be



(A) S_2, D_{in}, S_0, S_1
(B) S_1, D_{in}, S_0, S_2
(C) D_{in}, S_0, S_1, S_2
(D) D_{in}, S_2, S_0, S_1

[Ans. D]

40. In the ac equivalent circuit shown, the two BJTs are biased in active region and have identical parameters with $\beta \gg 1$. The open circuit small signal voltage gain is approximately _____.



[Ans. *] Range: -1 to -1

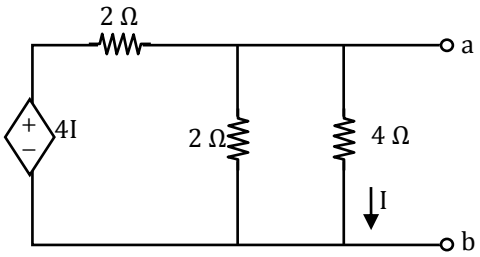
41. In a MOS capacitor with an oxide layer thickness of 10 nm, the maximum depletion layer thickness is 100 nm. The permittivity's of the semiconductor and the oxide layer are ε_s and ε_{ox}respectively. Assuming $\varepsilon_s/\varepsilon_{ox} = 3$, the ratio of the maximum capacitance to the minimum capacitance of this MOS capacitor is_____.

[Ans. *] Range: 4.33 to 4.33

42. Let the random variable X represent the number of times a fair com needs to be tossed till two consecutive heads appear for the first time. The expectation of X is_____

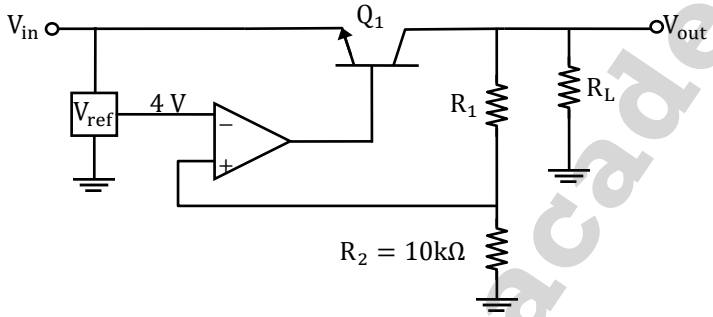
[Ans. *] Range: 1.5 to 1.5

43. In the circuit shown, the Norton equivalent resistance (in Ω) across terminals a-b is_____



[Ans. *] Range: 1.33 to 1.33

44. For the voltage regulator circuit shown, the input voltage (V_{in}) is 20V and the regulated output voltage (V_{out}) is 10 V. Assume the Op-Amp to be ideal. For a load R_L drawing 200 mA. The maximum power dissipation in Q_1 (m Watts) is_____.



[Ans. *] Range: 2.8 to 2.8

45. The state variable representation of a system is given as

$\dot{x} = \begin{bmatrix} 0 & 1 \\ 0 & -1 \end{bmatrix} x; x(0) = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$

$\dot{y} = [0 \quad 1]x$

The response y(t) is

(A) $\sin(t)$
(B) $1 - e^t$
(C) $1 - \cos(t)$
(D) 0

[Ans. D]

46. An air- filled rectangular waveguide of internal dimensions a cm x b cm [a >b) has a cutoff frequency of 6 GHz for the dominant TE_{10} mode. For the same waveguide, if the cutoff frequency of the TM_{11} mode is 15 GHz, the cutoff frequency of the TM_{01} mode in GHz is

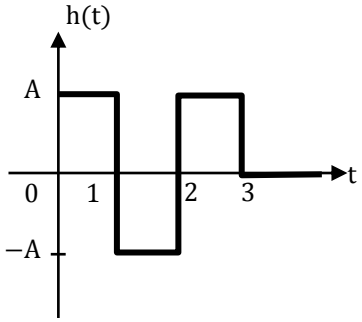
[Ans. *] Range: 13.75 to 13.75

47. The output of a standard second order system for a unit step input is given as $y(t) = 1 - \frac{2}{\sqrt{3}} e^{-t} \cos\left(\sqrt{3}t - \frac{\pi}{6}\right)$. The transfer function of the system of

(A) $\frac{2}{(s+2)(s+\sqrt{3})}$
(B) $\frac{1}{s^2 + 2s + 1}$
(C) $\frac{3}{s^2 + 2s + 3}$
(D) $\frac{4}{s^2 + 2s + 4}$

[Ans. D]

48. A zero mean white Gaussian noise having power spectral density $\frac{N_0}{2}$ is passed through an LTI filter whose impulse response h(t)is shown in the figure. The variance of the filtered noise at t = 4 is



(A) $\frac{3}{2}A^2N_0$

(B) $\frac{3}{4}A^2N_0$

(C) A^2N_0

(D) $\frac{1}{2}A^2N_0$

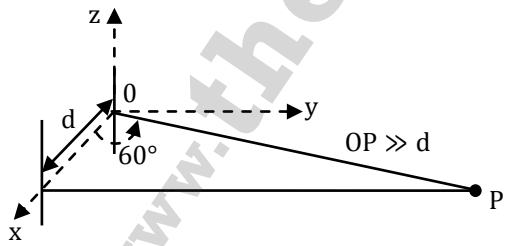
[Ans. A]

49. Let $x(t) = \alpha\, s(t) + s(-t)$with $s(t) = \beta e^{-4t}u(t)$, where u(t) is unit step function. If the bilateral Laplace transform of x(t) is

$X(s) = \frac{16}{s^2 - 16} - 4 < \text{Re}\{s\} < 4$. Then the value of β is _____

[Ans. *] Range: −2 to −2

50. Two half-wave dipole antennas placed as shown in the figure are excited with sinusoidally varying currents of frequency 3 MHz and phase shift of π/2 between them (the element at the origin leads in phase). If the maximum radiated E-field at the point P in the x-y plane occurs at an azimuthal angle of 60°, the distance d(in meters) between the antennas is _____



[Ans. *] Range: 50 to 50

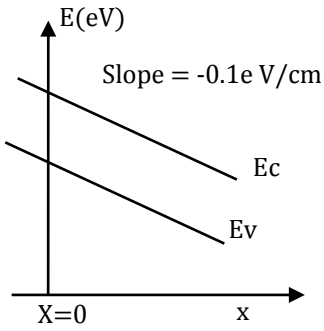
51. The value of the integral $\int_{-\infty}^{\infty} 12\cos(2\pi t)\frac{\sin(4\pi t)}{4\pi t}\,dt$ is _____

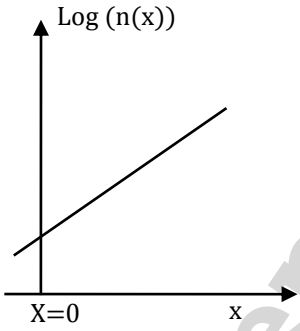
[Ans. *] Range: 3 to 3

52. If C denotes the counter clockwise unit circle, the value of contour integral $\frac{1}{2\pi j}\oint_c \text{Re}(z)dz$ is _____

[Ans. *] Range: 0.5 to 0.5

53. The energy diagram and the electron density profile n(x) in a semiconductor are shown in the figure. Assume that $n(x) = 10^{15} e^{\left(\frac{q\alpha x}{kT}\right)} cm^3$, with $\alpha = 0.1 V/cm$ and x expressed in cm. Given $\frac{kT}{q} = 0.026V, D_n = 36\ cm^2 s^{-1}$, and $\frac{D}{\mu} = \frac{kT}{q}$. The electron current density (in A/cm^2) at $x = 0$ is





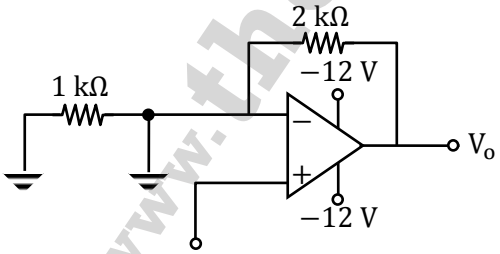
(A) -4.4×10^{-2}
(B) -2.2×10^{-2}
(C) 0
(D) 2.2×10^{-2}

[Ans. D]

54. A function of Boolean variables X. Y and Z is expressed in terms of the min terms as $F(X, Y, Z) = \sum(1, 2, 5, 6, 7)$ Which one of the product of sums given below is equal to the function F(X, Y, Z)?
(A) $(\bar{X} + \bar{Y} + \bar{Z}) \cdot (\bar{X} + Y + Z) \cdot (X + \bar{Y} + \bar{Z})$
(B) $(X + Y + Z) \cdot (X + \bar{Y} + \bar{Z}) \cdot (\bar{X} + Y + Z)$
(C) $(\bar{X} + \bar{Y} + Z) \cdot (\bar{X} + Y + \bar{Z}) \cdot (X + \bar{Y} + Z) \cdot (X + Y + \bar{Z}) \cdot (X + Y + Z)$
(D) $(X + Y + \bar{Z}) \cdot (\bar{X} + Y + Z) \cdot (\bar{X} + Y + \bar{Z}) \cdot (\bar{X} + \bar{Y} + Z) \cdot (\bar{X} + \bar{Y} + \bar{Z})$

[Ans. B]

55. Assuming that the Op-Amp in the circuit shown below is ideal, the output voltage V_0 (in volts) is _____



[Ans. *] Range: 12 to 12