RATHI CLASSES

आजीवनम् ज्ञानवर्धनम्

New mantra for Success

CPT-5

Communication Systems, Signals & Systems, Analog Electronics and EMT-1

(Electronics & Electrical Engineering)

Duration ~ 1:00 Hour **Maximum Marks ~ 50**

Read the following instructions carefully

1. This question paper contains 30 objective types questions carrying 50 marks. Q.1 to Q.10 (10 Questions) carry **ONE MARK** and Q.11 to Q.30 (20 Questions) and will carry **TWO MARKS** each.
2. Attempt all the questions.
3. Questions must be answered on **Objective Response Sheet (ORS)** by marking (A, B, C, D) using **Blue or Black ball pen** against the question number on the left hand side of **(ORS).** Each question has only one correct answer.
4. For **1 mark** multiple-choice questions, **1/3 marks** will be deducted for a wrong answer. Likewise, for **2 marks** multiple-choice questions, **2/3 marks** will be deducted for a wrong answer.

   There is NO negative marking for numerical answer type questions.
5. Write your registration number, your name and name of the examination centre at the specified locations on the right half of the **ORS**.
6. Calculator is allowed in the examinatinon hall.
7. Charts, graph sheets or tables are NOT allowed in the examination hall.
8. Rough work can be done on the question paper itself. Additionally blank pages are given at the end of the question paper for rough work.
9. This question paper contains 16 printed pages including 1 page for Rough Work. Please check all pages and report, if there is any discrepancy.

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Q.1 A coine is tossed two time then find the ratio of non-elementry event to that of the total possible event.

(a) $\frac{1}{4}$ (b) $\frac{11}{16}$

(c) $\frac{3}{4}$ (d) None

Q.2 It is given that $\alpha(x)$ is a function such that $\int_{-\infty}^{\infty} \alpha(x) = 1, \alpha(x) \geq 0$ and $P\{x_1 < x \leq x_2\} = \int_{x_1}^{x_2} \alpha(x)dx$ the conclusion can be drawn that probability of all elementry event of S (sample space) is zero

(a) for any $\alpha(x)$. (b) for bounded $\alpha(x)$.

(c) either (a) or (b) (d) None

Q.3 Let the order of transfer function is N if we adopt the Non-cononic realization methods then the numbers of delaly elements can be used.

(a) 2 N (b) 2 N + 1

(c) 4 N (d) any of the above

Q.4 A sequence x(n) with the z - transform $x(z) = z^4 + z^2 - 2z + 2 - 3z^{-4}$ is applied as an input to a LTI system with impulse response $h[n] = \delta[n - 3]$

where $\delta[n] = \begin{cases} 1, & n = 0 \\ 0, & \text{otherwise} \end{cases}$

the output at n = 7 is

(a) –6 (b) zero

(c) –3 (d) –4

Q.5 For an N-point FFT algorthim with $N = 2^m$ which one of the following statement is true

(a) It is not possible to construct a signal flow graph with both input and output is normal order

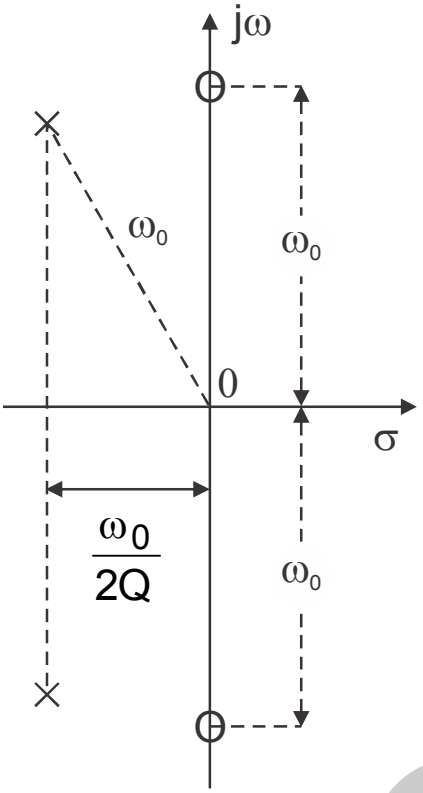
(b) Computation of a butterfly requires only one complex multiplication

(c) In place computation requires storages of only 2N node data

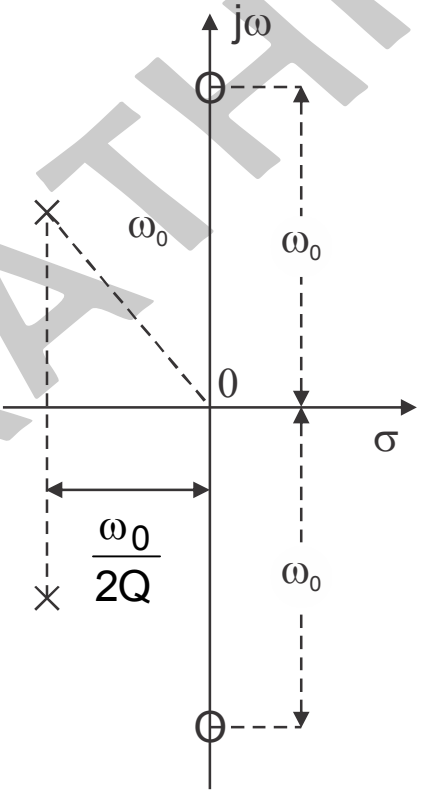
(d) Computation of a butterfly requires only ten complex multiplication

Q.6 Match the followings

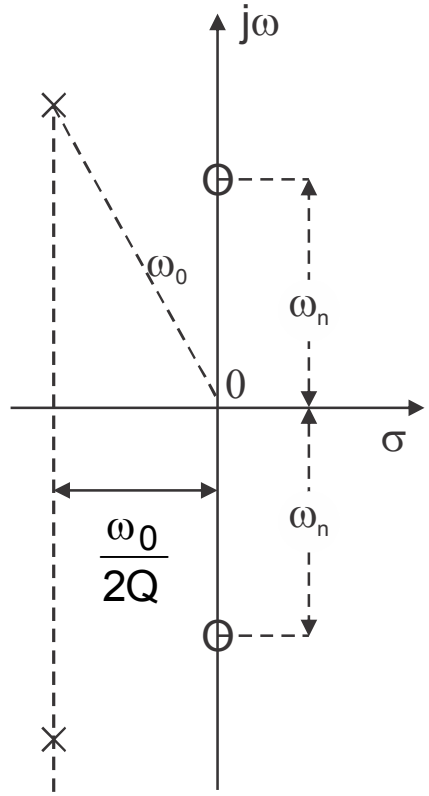
(A)



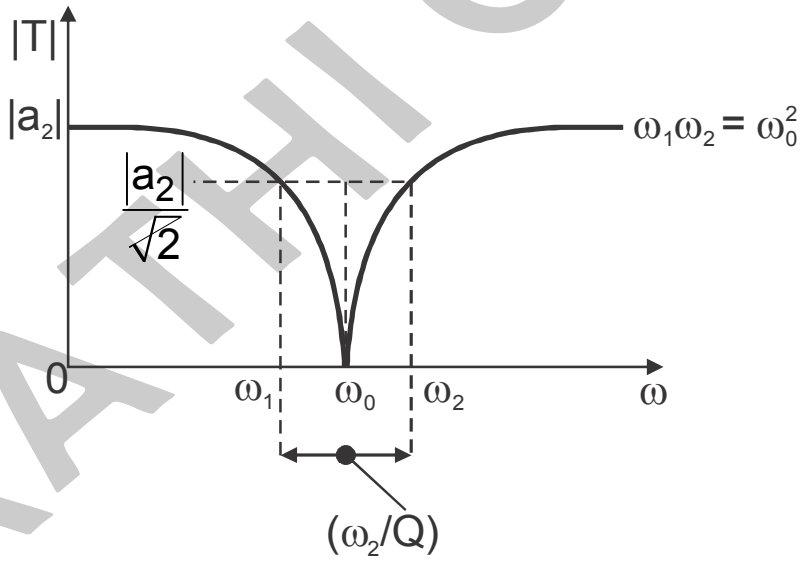
(B)



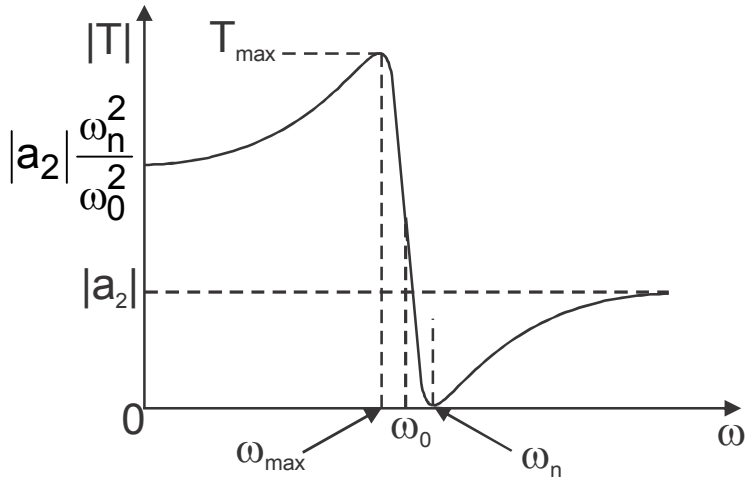
(C)



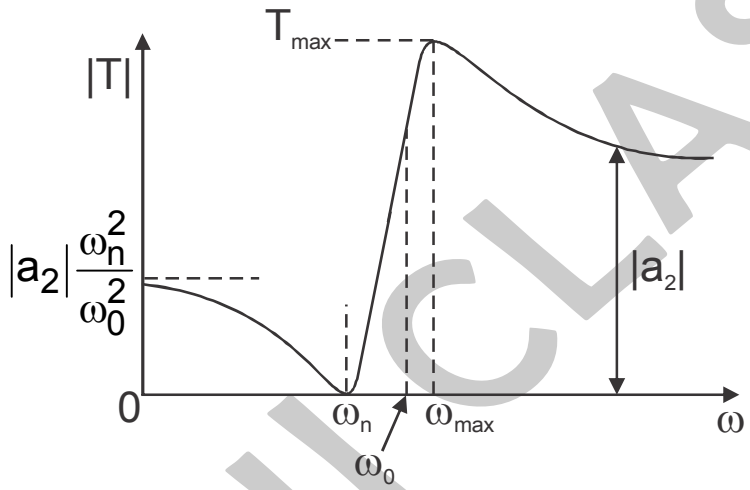
(1)



(2)



(3)



(a) A-1, B-3, C-2 (b) A-2, B-1, C-3

(c) A-1, B-2, C-3 (d) None

Q.7 Consider the statement CMOS identical circuit

Statement-1: Using a process technology with larger transconductance parameter k' can result in shorter propagation delay t_p.

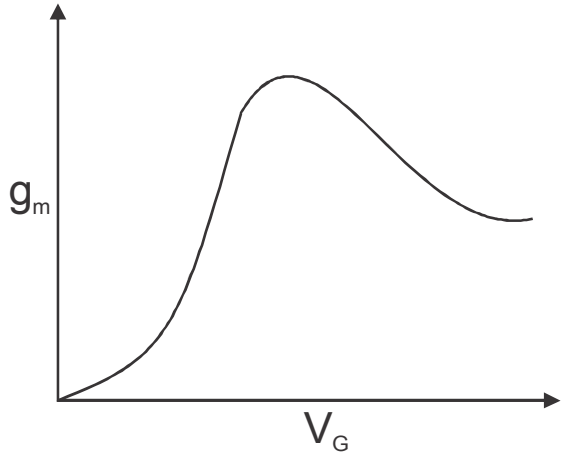
Statement-2: Larger supply voltage V_{DD} results in a lower the t_p.

(a) only (1) is true (b) only (2) is true

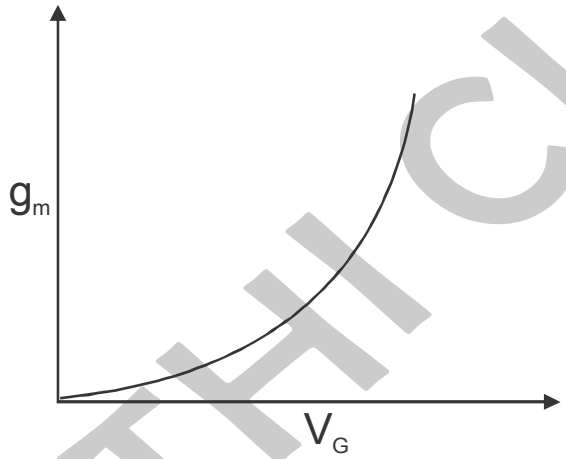
(c) both (1) and (2) is true (d) None is true

Q.8 The measured transconductance g_m of an NMOS transistor operating operating in the linear gegion is plotted against the gate voltage V_G at constant drain voltage V_D. Which of the following figures represent the expected dependence of g_m on V_G?

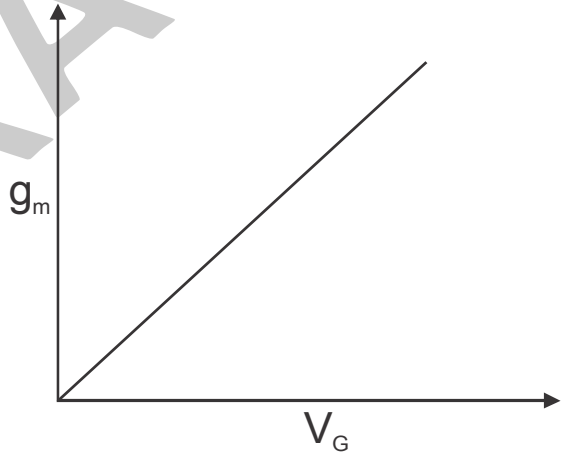
(a)



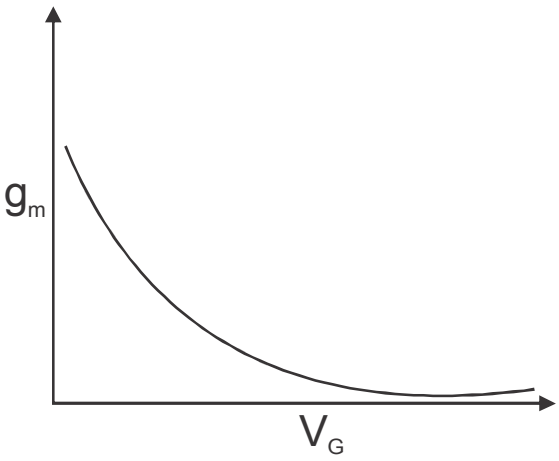
(b)



(c)



(d)

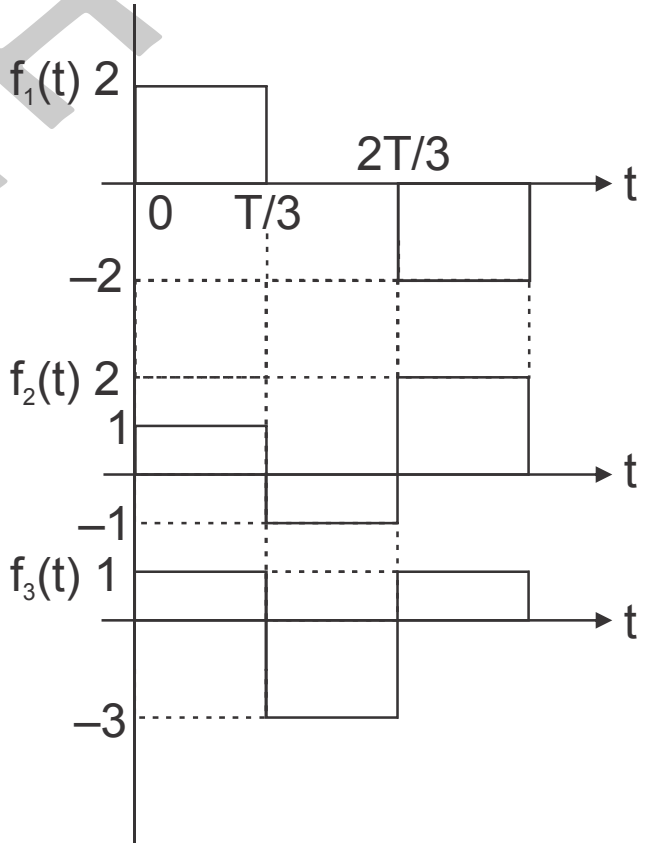


Q.9 Find the sum of sequence (Where m and n are real number, are greater than or equal to zero)

$$1+\frac{10}{19}+\frac{10\times 9}{19\times 18}+.....+\frac{n(n-1)...2.1}{(m+n-1)(m+n-2)...(m+1)m}$$ ———.

Q.10 If $A=\hat{x}2+\hat{y}0+\hat{z}$ and $B=\hat{r}2$ at $\theta=45°, \phi=0°$, find the angle between A and B _____.

Q.11 Three function $f_1(t)$, $f_2(t)$ and $f_3(t)$ which are zero outside the interval [0, T], are shown in the figure. Which of the following statement is correct?



(a) $f_1(t)$ and $f_2(t)$ are orthogonal

(b) $f_1(t)$ and $f_3(t)$ are orthogonal

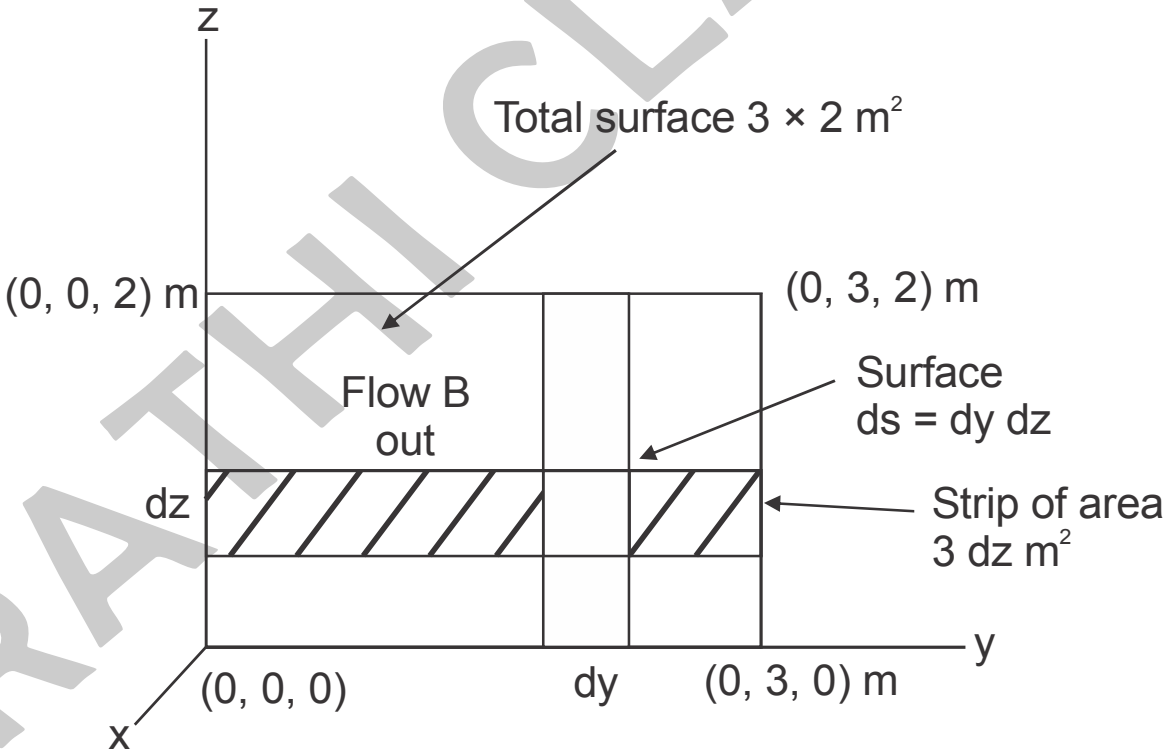
(c) $f_2(t)$ and $f_3(t)$ are orthogonal

(d) $f_1(t)$ and $f_2(t)$ are orthonormal

Q.12 If sonia wants to dilute her drink to the one third of strength of its initial state, suppose the initial volume of drink is 16 unit. She takes 3.842 unit of drink out and put same ammount of water "water unit" in the drink find number of operation she has to do _____.

Q.13 Find the work done in lifiting a 6-tonne ($m_s = 6 \times 10^3$ kg) satellite to GSO (geostationary orbit) height = 37,000 km. Where mass of earth = 6×10^{24} kg, gravitational constant = 6.67×10^{-11} N m^2 kg^{-2} is_____. MW-hr

Q.14 Water flowing in the x direction has a rate of flow as a function of y and z given by $B_x = 3yz$ liters min^{-1} m^{-2}. Find the total flow (or flux) of water through the rectangular area with corner (0, 0, 0), (0, 3, 0), (0, 0, 2) and (0, 3, 2) m _____. Liters min^{-1}

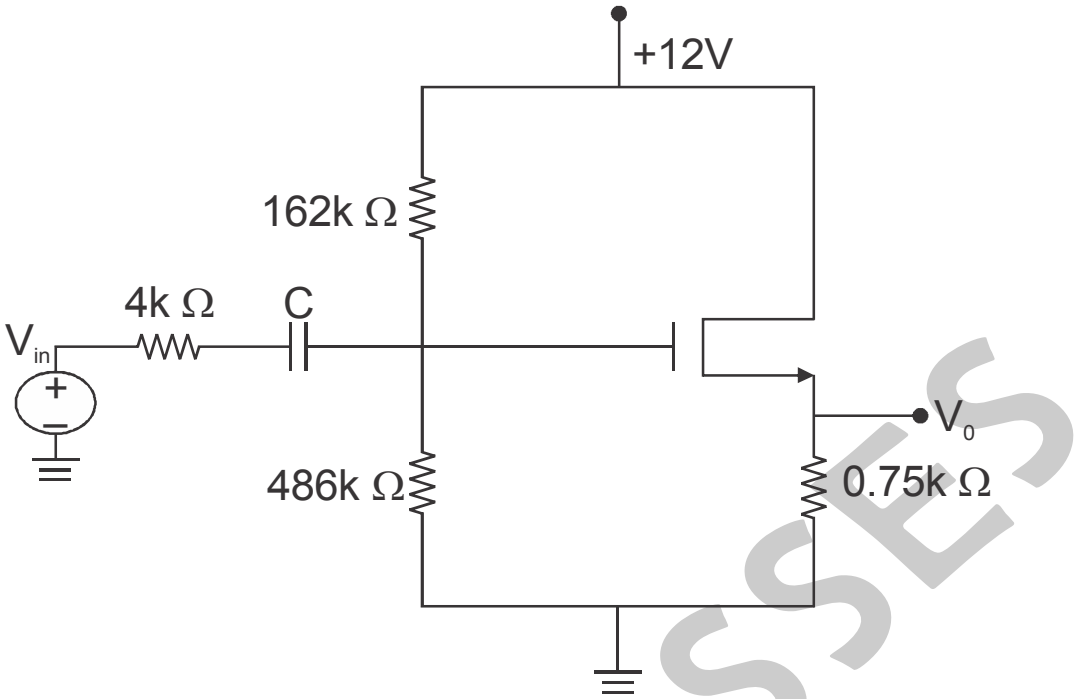


$$\text{Hint}: (\Psi = \text{flux}) = \iint B.ds = \iint B_x dy\ dz$$

Statement for Linked Answer Questions 15 to 16:

Q.15 The source follower amplifier circuit shown in the following figure.

Transistor parameters are $V_{th} = 1.2$ V, $K_n = 4$ mA/V^2, and $\lambda = 0.01\ V^{-1}$ small signal transconductance and I_D are

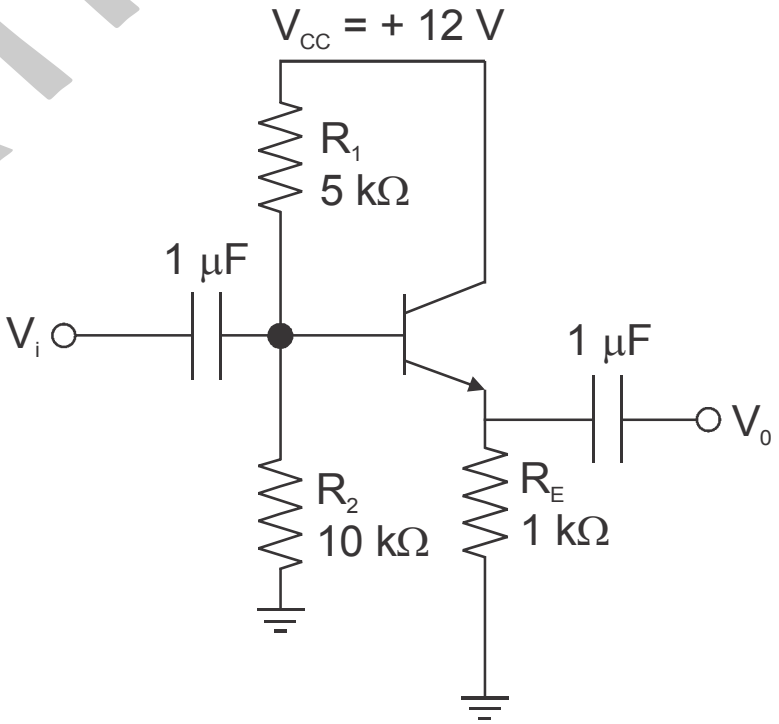


(a) 8.47 mA, 14.8 mA/V (b) 6.47 mA, 14.8 mA/V
(c) 6.47 mA, 11.6 mA/V (d) 8.47 mA, 11.6 mA/V

Q.16 Small signal voltage gain $A\nu = \frac{v_0}{V_i}$

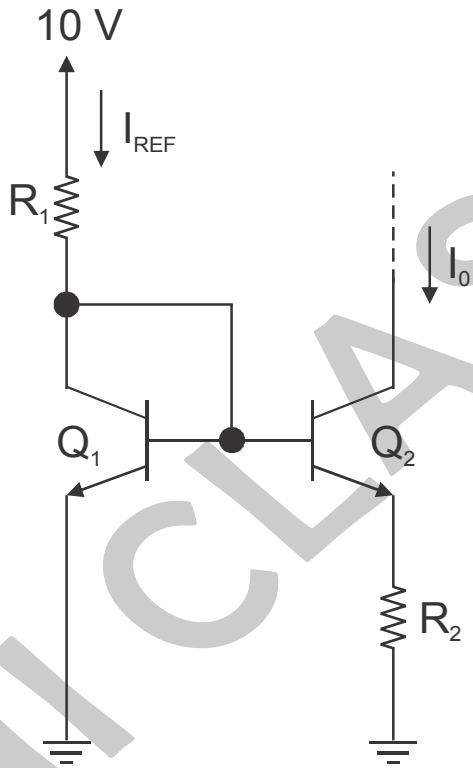
(a) 1.2 (b) 1.13
(c) 0.98 (d) 0.86

Q.17 For the common collector amplifier shown in the figure, the BJT has high β, negligible $V_{CE(sat)}$, and V_{BE} = 0.7 V. The maximum undistorted peak-to-peak output voltage ν_0 (in Volts) is _____.



Q.18 Let x(z) = $e^{1/z}$ with ROC all Z except $|z| = 0$ the value x(2) = _____.

Q.19 The circuit in the figure generate a constant current $I_0 = 10\ \mu A$ which operate from a 10V supply. Determine the values of the required resistors assuming that V_{BE} is 0.7 V at current of 1 mA and neglecting the effect of finite β.



(a) R_1 = 9.3 kΩ, R_2 = 11.1 kΩ

(b) R_1 = 9.1 kΩ, R_2 = 11.5 kΩ

(c) R_1 = 9.1 kΩ, R_2 = 9.3 kΩ

(d) R_1 = 9.3 kΩ, R_2 = 11.5 kΩ

Q.20 The 4-point discrete fourier transform (DFT) of a discrete time sequence x[n] = [K, 0, 2, I] is x(k) = [6, m, 0, n] find the value of (k, l, m, n)

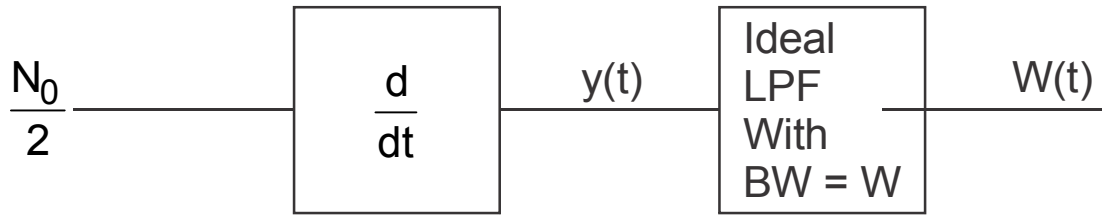
(a) {1, 0, 2, 3}

(b) $\{1, 3, -1+3j, -1-3j\}$

(c) $\{3, 1, -1-3j, -1+3j\}$

(d) None

Q.21 The output power in the undermentioned circuit is given by AWGN with S × (f) =



(a) $\frac{4}{3}N_0\pi^2w^2$ (b) $\frac{4}{3}N_0\pi^2w^3$

(c) $\frac{2}{3}N_0\pi^2w^2$ (d) $\frac{2}{3}N_0\pi^2w^3$

Q.22 The autocorrelation function of a random process X(t) is given by $R_x(\tau) = 2 + 3\ e^{-5|\tau|}$. The total power of the random process is

(a) 2 W (b) 4 W

(c) 2.5 W (d) None

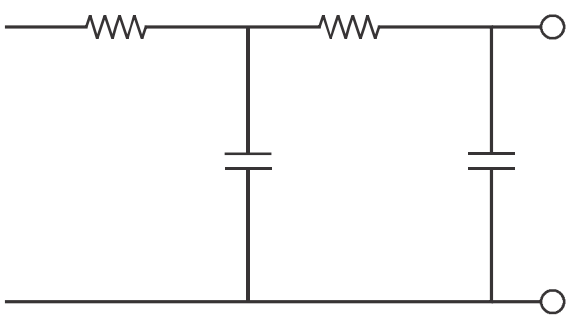
Q.23 An AWGN process X(t) is passed through R–L, low pass filter with cut-off frequency f_c = 1 and unity DC gain. If $\frac{N_0}{2}$ is spectral density of X(t), the autocorrelation function of output process is given by

(a) $\frac{N_0}{2\pi}e^{-2\pi|\tau|}$ (b) $\frac{N_0}{2\pi}e^{-\pi|\tau|}$

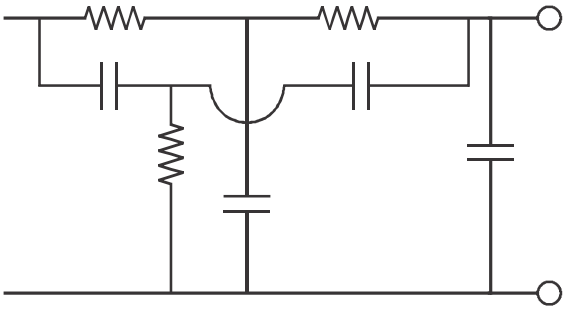
(c) $\frac{N_0}{\pi}e^{-2\pi|\tau|}$ (d) $\frac{N_0}{\pi}e^{-\pi|\tau|}$

Q.24 Which of the following is a pre-emphasis filter.

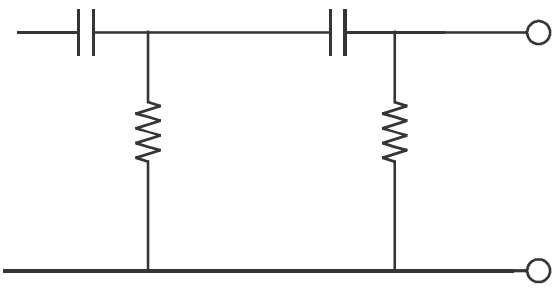
(a)



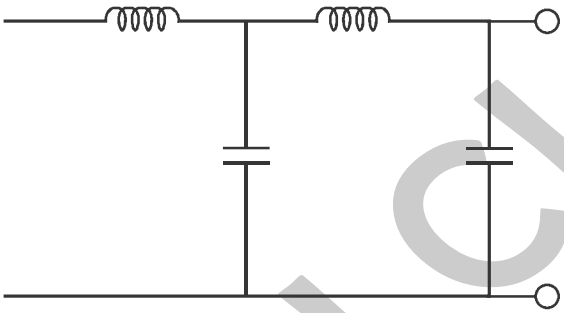
(b)



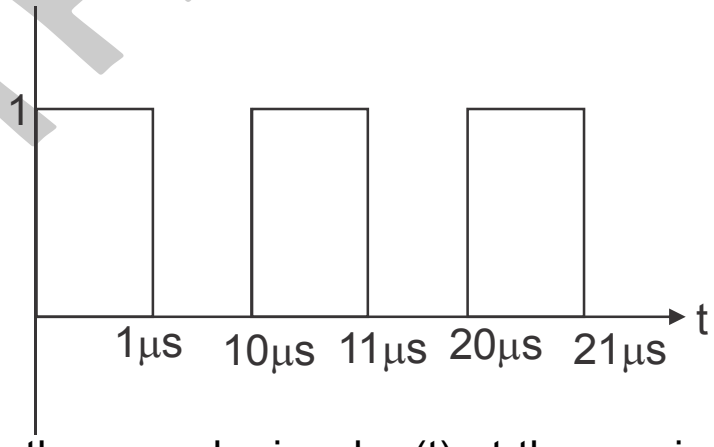
(c)



(d)



Q.25 A speech signal m(t) is pulse amplitude modulated with pulse train mentioned below.



To regenerate the speech signal m(t) at the receiver, the transfer function of regeneration filter is

(a) $\frac{1}{10^{-6}\,\text{sinc}\left(10^{-6}f\right)}$ (b) $10^{-6}\,\text{sinc}\left(10^{-6}f\right)$

(c) $\frac{1}{10^{-5}\,\text{sinc}\left(10^{-5}f\right)}$ (d) $\frac{1}{10^{-5}\,\text{sinc}\left(10^{-5f}\right)}$

Q.26 Let a random variable X is taking the values in the range of (–2, 2) with uniform density. If R_v X is represented by two quantization levels as below

$X_q = -0.5$ if $X \in (-2, 0)$

$X_q = 0.5$ if $X \in (0, 2)$

The quantization noise power with this quantizer is

(a) 1.0 W. (b) 0.5 W.

(c) 2.0 W. (d) 0.8 W.

Q.27 If Gray coding is used in a 64-array PSK modulation, the approximate value of symbol error and bit error if the 64-array symbols are transmitted in AWGN environment with power special density $\frac{N_0}{2}$

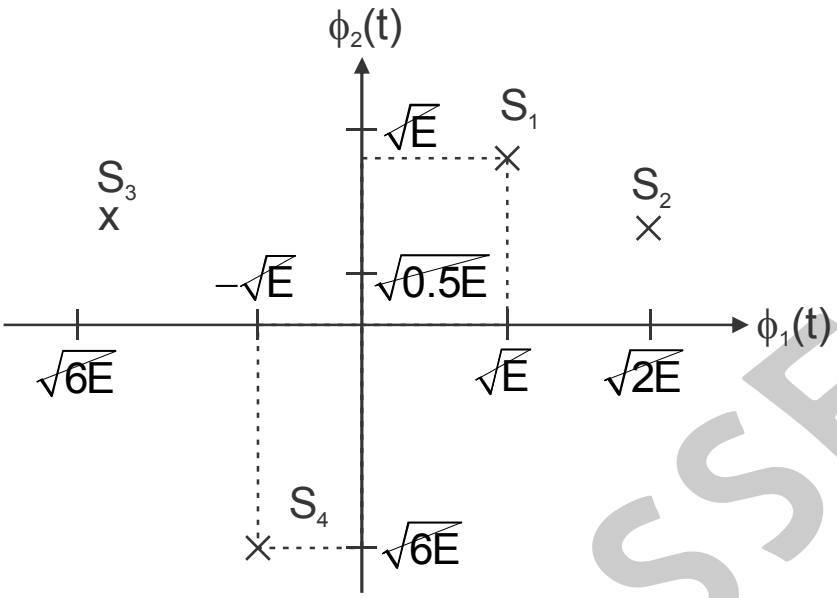
(a) $P_S = \frac{1}{2}\text{erfc}\left(\sqrt{\frac{E}{N_0}\sin\frac{\pi}{64}}\right),\ P_e = \frac{1}{2}\text{erfc}\left(\sqrt{\frac{E}{N_0}\sin\frac{\pi}{64}}\right)$

(b) $P_S = \frac{1}{2}\text{erfc}\left(\sqrt{\frac{E}{N_0}\sin\left(\frac{\pi}{120}\right)}\right),\ P_e = \frac{1}{2}\text{erfc}\left(\sqrt{\frac{E}{N_0}\sin\left(\frac{\pi}{210}\right)}\right)$

(c) $P_S = \frac{1}{2}\text{erfc}\left(\sqrt{\frac{E}{N_0}}\sin\left(\frac{\pi}{64}\right)\right),\ P_e = \frac{1}{12}\text{erfc}\left(\sqrt{\frac{E}{N_0}}\sin\left(\frac{\pi}{64}\right)\right)$

(d) None of the above

Q.28 The signal space diagram for a pass-band modulation is given as follows.



The approximate value of probability of symbol error if all the four symbols are transmitted with equal probability is (assume AWGN with PSD $N_0/2$).

(a) $\frac{1}{2}\text{erfc}\left(\sqrt{\frac{E}{N_0}}\right)$ (b) $\frac{1}{2}\text{erfc}\left(\sqrt{\frac{E}{2N_0}}\right)$

(c) $\frac{1}{4}\text{erfc}\left(\sqrt{\frac{E}{\sqrt{2N_0}}}\right)$ (d) $\frac{1}{4}\text{erfc}\left(\frac{\sqrt{E}}{4\sqrt{N_0}}\right)$

Q.29 The output communication channel by using BPSK modulation modulation is given by

$$x(t) = \pm\sqrt{E_b}\phi_1(t) + |w(t)|$$

where w(t) is AWGN with power spectral density $\frac{N_0}{2}$. If 1 represented by $\sqrt{E_b}\phi(t)$,

0 is represented by $-\sqrt{E_b}\phi_1(t)$

$|w(t)|$ is the modules of w(t) and coherent detector is used at receiver with the threshold value $\lambda = 0$.

The probability of error if symbol '0' is transmitted, is given by

(a) zero

(b) $\frac{1}{2}\text{erfc}\left(\sqrt{\frac{E_b}{N_0}}\right)$

(c) $\text{erfc}\left(\sqrt{\frac{E_b}{N_0}}\right)$

(d) $\frac{1}{2}\text{erfc}\left(\frac{\sqrt{E_b}}{2N_0}\right)$

Q.30 The generator matrix of a linear block code is mentioned as

$$G = \begin{bmatrix} 1 & 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 \end{bmatrix}$$

The minimum distance of the code is

(a) 1

(b) 2

(c) 3

(d) 9

(End of the question paper)

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(SPACE FOR ROUGH WORK)