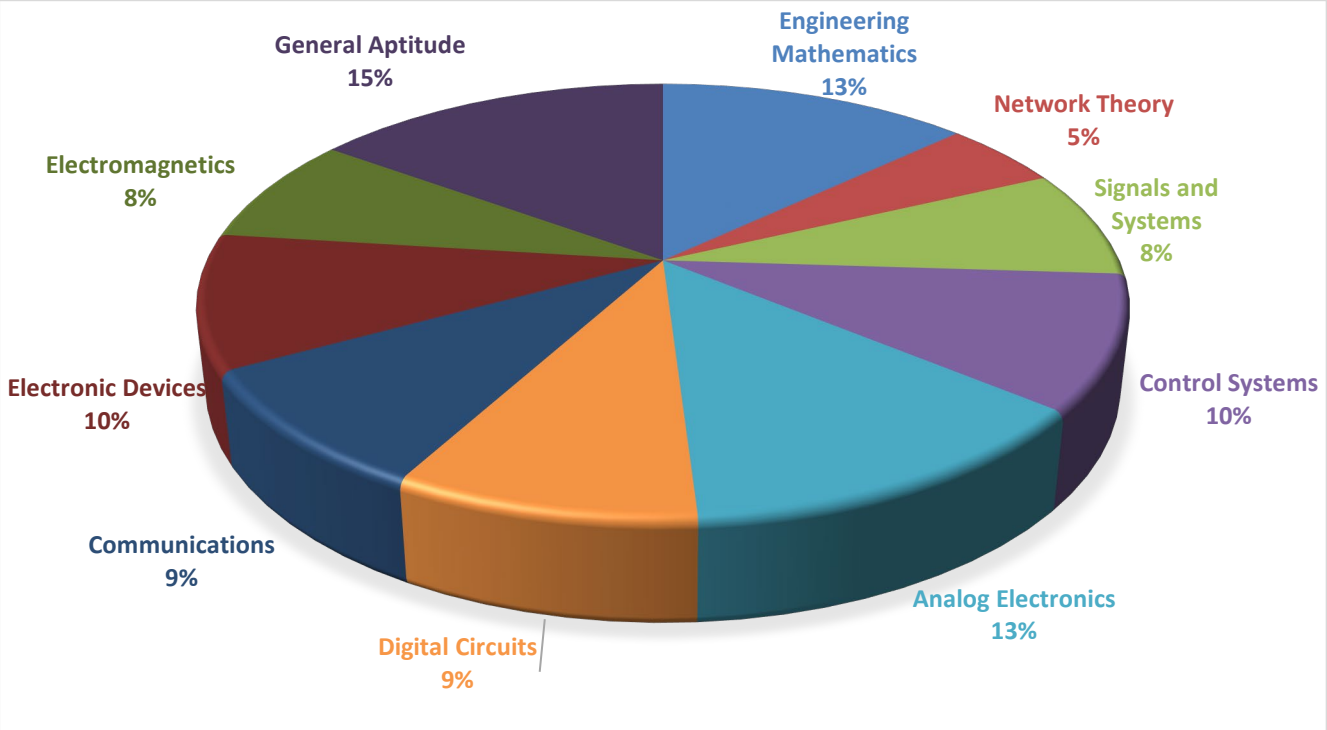
# ANALYSIS OF GATE 2020

Memory Based

## Electronics and Communication Engineering



# ECE ANALYSIS-2020_Feb-2_Afternoon

| SUBJECT | No. of Ques. | Topics Asked in Paper(Memory Based) | Level of Ques. | Total Marks |
|---|---|---|---|---|
| Engineering Mathematics | 1 Marks:5<br>2 Marks:4 | Probability, Uniform distribution, partial derivative, Systems of equation, Triple integral | Average | 13 |
| Network Theory | 1 Marks:3<br>2 Marks:1 | Maximum power transfer theorem, Two port network | Average | 5 |
| Signals and Systems | 1 Marks:2<br>2 Marks:3 | LTI, Discrete, FT, DFT | Difficult | 8 |
| Control Systems | 1 Marks:2<br>2 Marks:4 | Nyquist, RH Criteria, Frequency response, RL-Bode plot, State space | Average | 10 |
| Analog Electronics | 1 Marks:3<br>2 Marks: 5 | OP-AMP, small signal analysis | Average | 13 |
| Digital Circuits | 1 Marks:3<br>2 Marks:3 | State diagram ,Multiplexer, 8085 microprocessor | Average | 9 |
| Communications | 1 Marks:3<br>2 Marks:3 | Bit error rate, Entropy, Variance, Instantaneous frequency, Maximum likelihood decoding, Double side band suppressed carrier demodulation | Average | 9 |
| Electronic Devices | 1 Marks:2<br>2 Marks:4 | Intrinsic semiconductor, p-n junction, Fermi level | Difficult | 10 |
| Electromagnetics | 1 Marks:2<br>2 Marks:3 | Smit Chart, Transmission lines | Average | 8 |
| General Aptitude | 1 Marks:5<br>2 Marks:5 | Analogy, English, Clock | Moderate to Difficult | 15 |
| Total | 65 | | | 100 |
| Faculty Feedback | Even though some subjects questions are tricky it's compensated by easy questions in other subjects. So, overall papers is moderate. Almost on par with GATE 2019 paper. | | | |

# GATE 2020 Examination* (Memory Based)

## Electronics and Communication Engineering

**Test Date: 2nd Feb-2020**

**Test Time: 2.30 pm to 5.30 pm**

**Stream Name: Electronics and Communication Engineering**

## General Aptitude

**Q.1 - Q.5 Carry One Mark each.**

1. Select the word that fits analogy:
Explicit : Implicit :: Express: _____
(A) Repress
(B) Compress
(C) Suppress
(D) Impress

2. He was not only accused of theft _____ of conspiracy
(A) Rather than
(B) Rather
(C) But also
(D) But even

**Q.6 - Q.10 Carry Two Mark each.**

6. A super additive function f(.)satisfies the property $f(x_1 + x_2) \geq f(x_1) + f(x_2)$ which of the following is a super addition function for $> 1$ ?
(A) $\sqrt{x}$
(B) $e^x$
(C) $e^{-x}$
(D) $\frac{1}{x}$
**[Ans. B]**

7. It is quarter past three in your watch the angle between hour hand and min hand is
(A) 15°
(B) 0°
(C) 7.5°
(D) 22.5°
**[Ans. C]**

8. The untimely loss of life is a course of serious global concern as thousands of people get killed_____accidents every year while many other die_____disease like cardiovascular disease, cancer etc.
(A) from of
(B) in of
(C) during from
(D) from from
**[Ans. B]**

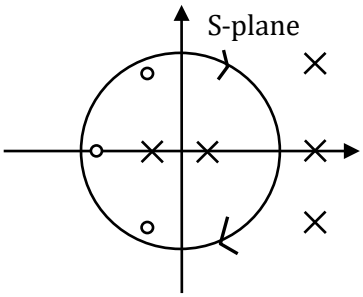
9. The Canadian constitution requires equal importance to English and French. Last year air Canada lost a lawsuit and had to pay a six figure fine to French speaking couple after they field a complaints about formal in-flight announcements in English last in 15 sec as opposed to informal 5 sec message in French.
The French speaking couples were upset at_____
(A) The English announcements being longer than French once
(B) The English announcement being clear than French
(C) Equal importance given to English and French
(D) The in-flight announcement being made in English

10. The global financial crisis in 2008 as considered to be most serious worldwide FC. Which started with sub-prime lending crisis (SPLC) in USA 2007? The SPLC led to banking crisis in 2008 with the collapse of Lehman brothers in 2008. The SPL refers to the provision of loans to those borrowers. Who may have difficulties in repaying loans and its arises because of excess liquidity following the East Asian crisis.
The correct precedence according to paragraph is
(A) Banking crisis →sub-prime lending crisis→global financial crisis→east Asian crisis
(B) sub-prime lending crisis→ global financial crisis → Banking crisis → east Asian crisis
(C) global financial crisis → east Asian crisis→ Banking crisis → sub – prime lending crisis
(D) east Asian crisis→ sub – prime lending crisis → Banking crisis → global financial crisis

# Technical

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

**1.** A pole zero map of a rational function G(s) is shown. When the closed contour Γ is mapped into G(s) plane, then the mapping encircles




(A) The point $(-1 + j0)$ of G(s) plane once in the counter clockwise direction
(B) The point $(-1 + j0)$ of G(s) plane once in the clockwise direction
(C) The origin of G(s) plane once in counter clockwise direction
(D) The origin of G(s) plane once in clockwise direction
**[Ans. D]**

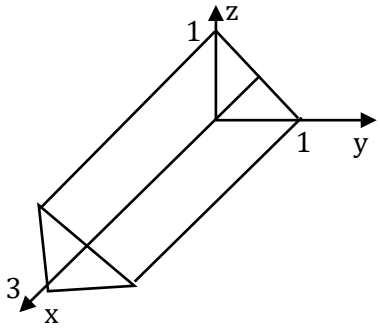
**2.** Two sides of a fair win are labelled as 0 and 1. The coin is tossed two times independently. Let M and N denote labels corresponding to the outcomes of those tosses. For a random variable $X = \min(M, N)$, $E(X) =$ _____
**[Ans. *]Range: 0.25 to 0.25**

**3.** $V_1, V_2, V_3, V_4, V_5, V_6$ are six vector in $R^4$ which of the following statements is false?
(A) Any 4 vectors form basis for $R^4$
(B) If $V_1, V_3, V_5, V_6$ span $R^4$ then it forms a basis of $R^4$
(C) These vectors are not linearly independent
(D) It is not necessary that vector span $R^4$
**[Ans. A]**

**4.** The general solution of $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 9y = 0$ is _____.
(A) $y = (C_1 + C_2x)e^{3x}$
(B) $y = C_1e^{3x} + C_2e^{-3x}$
(C) $y = C_1e^{3x}$
(D) $y = (C_1 + C_2x)e^{-3x}$
**[Ans. A]**

**5.** For a vector field A, which of the following is false?
(A) $\nabla \times A$ is another vector field
(B) A is irrotation if $\nabla^2 A = 0$
(C) $\nabla \times \nabla \times A = \nabla(\nabla . A) - \nabla^2 A$
(D) A is solenoidal if $\nabla . A = 0$
**[Ans. B]**

**6.** If $I = \iiint_s x\, dx\, dy\, dz$ and region is given




The value of I is _____.

**7.** Which of following pole-zero plot corresponds to L.T.I system characteristics by the differential equation

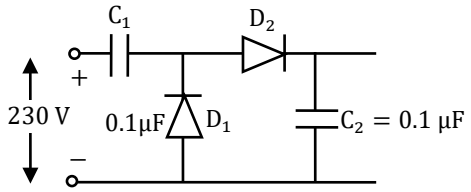
$$y(n) = \sum_{K=0}^{3} (-1)^K X(n-K)$$

**8.** D. T signals output is
$y(n) = \max [X(k)] , -\infty \leq K \leq n$
The unit response is
(A) $1\ \forall n$
(B) $u(n)$
(C) $0\ \forall n$
(D) $2\forall n$

**9.** A digital communication system is used to transmit a block of N-bits, if the probability of receiving 1-bit in error is a $\alpha$ and all bits are transmitted independently. The received block is said to be erroneous if at least one bit in error. The probability of the block to be erroneous is _____.
(A) $\alpha^n$
(B) $1 - (1-\alpha)^N$
(C) $N(1-\alpha)$
(D) $1 - \alpha^N$
**[Ans. B]**

**10.** A binary random variable= (x) takes 2 values as +2 (α) −2 with probabilitys. $P(x = 2) = \alpha$
The value of α(Rounded off to 1 decimal) for which entropy of x is max is _____
**[Ans. *]Range: 0.4 to 0.6**

**11.** In circuit all components ideal input sinusoidal magnitude of steady state output $V_o$ is _____



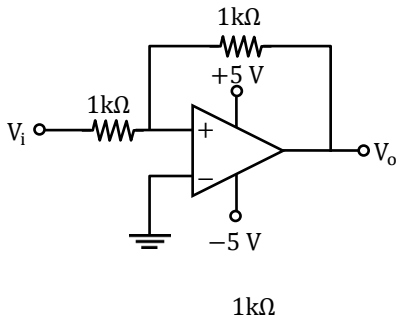

**[Ans. *]**

**12.** The impedance $Z = jx$ for all x belongs to $(-\infty, \infty)$maps to smith chart
(A) a circle of radius '1' with C (0, 0)
(B) a point at center of chart
(C) a line passing through the center of the chart
(D) a circle of radius 0.5 with (0.5, 0)
**[Ans. A]**

**13.** A single crystal intrinsic semiconductor at $T = 300K$ is considered. The effective density of states for holes in twice effective of states for electrons. Given $KT = 26$ meV. The intrinsic fermi level is shifted from mid bandgap energy level by
(A) 26.9 meV
(B) 9.01 meV
(C) 13.45 meV
(D) 18.02 meV

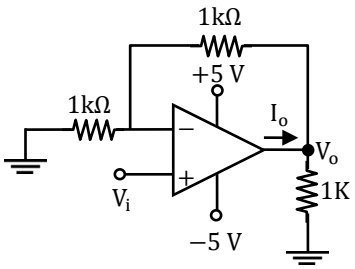
**14.** The loop transfer function of a negative feedback system is $G(s)H(s) = \frac{K(s+11)}{s(s+2)(s+8)}$. The value of K for which system is marginal stable is _____
**[Ans. *]Range: 160 to 160**

**15.** The components in circuit are ideal. Output is +ve feedback and input is sinusoidal of 1V then $V_o$ is _____



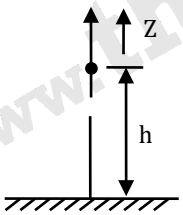

**[Ans. *]Range: 5 to 5**

**16.** The components in circuit are ideal. If $V_i$ is + 2V, the current $I_o$ sourced by op-Amp is _____ mA.




**[Ans. *]Range: 6 to 6**

**17.** For an infinitesimally small dipole in free space. The electric field $E_\theta$ is proportional to $\frac{e^{-jkr}}{r}\sin\theta$. The current element is kept at a distance 'h' above infinite conducting sheet as shown in figure.

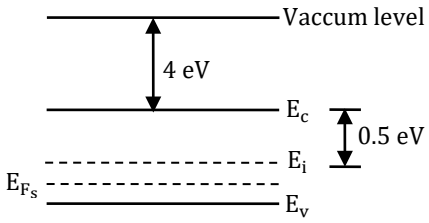



Minimum value of 'h' for which one of the maxima in far field radiation pattern occurs at $\theta = 60°$ is

(A) 0.5d
(B) 0.25d
(C) 0.75d
(D) d

**[Ans. A]**

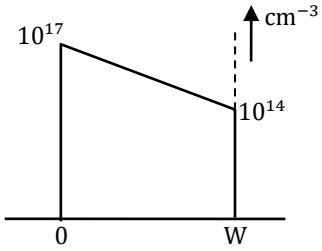
**18.** A mass capacitor is made of semiconductor material of band gap 1 eV. The energy band diagram of MOS capacitor is as shown in the figure below. Oxide capacitance $C_{ox} = 100\ nF/cm^2$, Threshold voltage $V_{Th} = -0.16$ eV. The metal work function $\phi_m = 3.87$ eV.




The magnitude of Depletion charges per unit area ($col/cm^2$) is _____

(A) $0.52 \times 10^{-8}$
(B) $0.93 \times 10^{-8}$
(C) $1.7 \times 10^{-8}$
(D) $1.41 \times 10^{-8}$

**19.** Consider two BJTs $T_1$ and $T_2$. Base region of $T_1$ is linearly doped as shown in the figure below




and that of $T_2$ is uniformly doped at $10^{17}/cm^3$. The common emitter current gain at transistor $T_2$ is

(A) 2.5 times that of $T_1$
(B) 0.7 times that of $T_1$
(C) 2 times that of $T_1$
(D) 0.3 times of $T_1$

**20.** A random variable is given by

$$Y = \int_{-\infty}^{\infty} w(t)\phi(t)dt \text{ where } \phi(t) = \begin{cases} 1; & 5 \le t \le 7 \\ 0; & \text{otherwise} \end{cases}$$

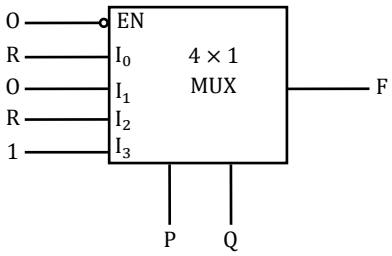
and w(t) is a real white Gaussian noise process with 2-sides power spectral density $\delta\omega(F) = 3\ W/Hz\ \forall\ F$. The variance of Y is_____

**21.** In an 8085 micro-processor, the no. of address lines required to access a 16 Kbyte memory bank is _____.

**[Ans .*]Range: 14 to 14**

**22.** A 10-bit digital to analog converter is calibrated over the full range from 0 to 10 V. If the input to the DAC is $(13\ A)_{16}$, then the output is _____Volts. (upto 3 decimal places)
**[Ans. *]Range: 3.066 to 3.069**

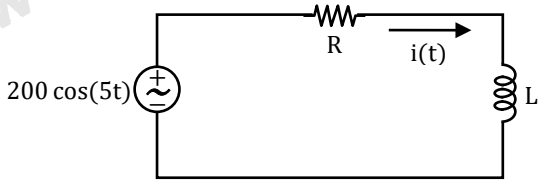
**23.** The figure below shows a multiplexer, where $S_1$ and $S_0$ are the select lines, $I_0$ to $I_3$ are input data lines, EN is the enable line & F(P, Q, R) is the output F is




(A) $P\overline{Q}R + \overline{P}Q$
(B) $P + Q\overline{R}$
(C) $\overline{Q} + PR$
(D) $PQ + \overline{Q}R$
**[Ans. D]**

**24.** C.E of the systems$^3 + 3s^2 + (k + 2)s + 3k = 0$. R.L plot for the system as K varies from 0 to $\infty$. The breakaway point lie with in
(A) $(-2, -1)$
(B) $(-3, -2)$
(C) $(-\infty, -3)$
(D) $(-1,0)$
**[Ans. D]**

**25.** The circuit in RL circuit is $i(t) = 10\cos\left(5t - \frac{\pi}{4}\right)$ A. The value of inductor is _____ H. (Upto 2 decimal places)




**[Ans. *]Range: 2.83 to 2.83**

**Q.26 - Q.55 Carry Two Mark each.**

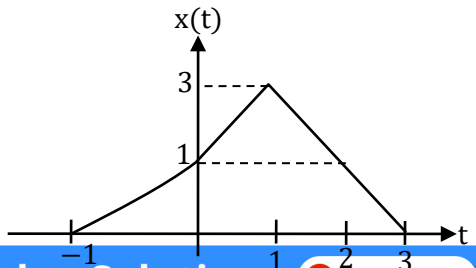
**26.** For a random variables X following uniform distribution $X \in [-2, 10]$ and $Y = 2x - 6$, $P(Y \leq 7 | x \geq 5)$=_____.

**27.** For the given system
$x_1 + 2x_2 = b_1$
$2x_1 + 4x_2 = b_2$
$3x_1 + 7x_2 = b_3$
$3x_1 + 9x_2 = b_4$
The solution of the system is
(A) $b_3 = 2b_1;\ 6b_1 - 3b_3 + b_4 = 0$
(B) $b_3 = 2b_1; 3b_1 - 6b_3 + b_4 = 0$
(C) $b_2 = 2b_1; 6b_1 - 3b_3 + b_4 = 0$
(D) $b_2 = 2b_1; 3b_1 - 6b_3 + b_4 = 0$
**[Ans. C]**

**28.** Which one of the following options contains two solution of differential equation
$\frac{dy}{dx} = (y-1)x$
(A) $\ln|y-1| = 0.5x^2 + c$, and $y = -1$
(B) $\ln|y-1| = 2x^2 + c$, and $y = -1$
(C) $\ln|y-1| = 2x^2 + c$, and $y = 1$
(D) $\ln|y-1| = 2x^2 + c$, and $y = 1$
**[Ans. D]**

**29.** If $\frac{\partial}{\partial x}\left(e^{1-x\cos y} + xz\, e^{-\frac{1}{1+y^2}}\right)\Big|_{(1,0,e)} = ?$
(A) 1
(B) 0
(C) $-1$
(D) $\frac{1}{e}$
**[Ans. B]**

**30.** $X(\omega)$ is F.T of $x(t)$ . The value of
$\int_{-\infty}^{\infty} (X(\omega))^2 . 2\omega$ is _____



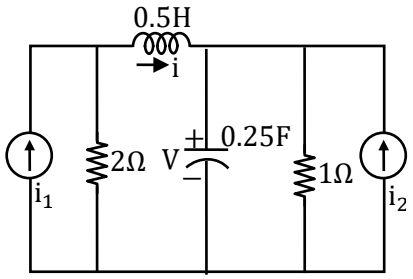
**31.** A finite duration D.T signals x(n) is obtained by sampling $x(t) = \cos[200\pi t]$ of sample instant $t = \frac{n}{400}, n = 0, 1, 2 \ldots 7$. The 8-point DFT of x(n) is defined as

$$X[k] = \sum_{n=0}^{7} x(n).\, e^{-i\frac{\pi K}{4}n}, K = 0, 1, \ldots .7$$

(A) Only X(3) and X(5) are non-zero
(B) Only (4) and X(5) are non-zero
(C) Only X(2) and X(6) are non-zero
(D) All X(K) are non-zero

**32.** The transfer function of a stable discrete time LTI system is $H(z) = \frac{K(z-\alpha)}{(z+0.5)}$ when α and K are constants and $|\alpha| > 1$. If the magnitude response is constant for all frequencies then the value of α is _____

**33.** For the given circuit which of the following is the correct state equation




(A) $\frac{d}{dt}\begin{bmatrix} V \\ i \end{bmatrix} = \begin{bmatrix} -4 & -4 \\ -2 & -4 \end{bmatrix}\begin{bmatrix} V \\ i \end{bmatrix} + \begin{bmatrix} 4 & 0 \\ 0 & 4 \end{bmatrix}\begin{bmatrix} i_1 \\ i_2 \end{bmatrix}$

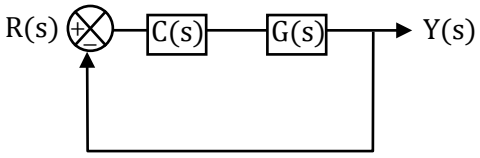
(B) $\frac{d}{dt}\begin{bmatrix} V \\ i \end{bmatrix} = \begin{bmatrix} -4 & 4 \\ -2 & -4 \end{bmatrix}\begin{bmatrix} V \\ i \end{bmatrix} + \begin{bmatrix} 0 & 4 \\ 4 & 0 \end{bmatrix}\begin{bmatrix} i_1 \\ i_2 \end{bmatrix}$

(C) $\frac{d}{dt}\begin{bmatrix} V \\ i \end{bmatrix} = \begin{bmatrix} 4 & -4 \\ -2 & -4 \end{bmatrix}\begin{bmatrix} V \\ i \end{bmatrix} + \begin{bmatrix} 0 & 4 \\ 4 & 4 \end{bmatrix}\begin{bmatrix} i_1 \\ i_2 \end{bmatrix}$

(D) $\frac{d}{dt}\begin{bmatrix} V \\ i \end{bmatrix} = \begin{bmatrix} -4 & -4 \\ -2 & 4 \end{bmatrix}\begin{bmatrix} V \\ i \end{bmatrix} + \begin{bmatrix} 4 & 4 \\ 4 & 0 \end{bmatrix}\begin{bmatrix} i_1 \\ i_2 \end{bmatrix}$

**[Ans. B]**

**34.** $G(s) = \frac{1}{s(s+1)}; C(s) = \frac{K(s+1)}{s+3}$




If steady state error for a unit ramp is 0.1, then the value of K is _____

**[Ans. *]Range: 30 to 30**

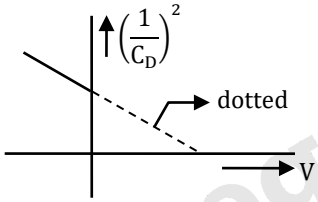
**35.** A system with transfer function $G(s) = \frac{1}{(s+1)(s+a)}; a > 0$ is subjected to an input $5\cos 3t$. The steady state output of the system is $\frac{1}{\sqrt{10}}\cos(3t - 1.892)$. The value of a is _____

**[Ans. *]Range: 4 to 4**

**36.** Magnetic field intensity of uniform plane wave in vacuum is
$H(x, y, z, t) = (\hat{a}_x + 2\hat{a}_y + b\hat{a}_z)$as $(\omega t + 3x - y - z)$
The value of b is _____

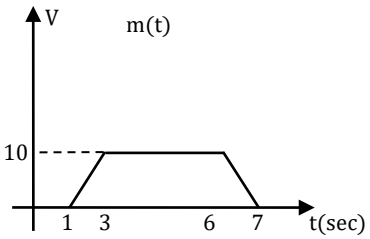
**37.** A p-n junction solar cell of area $1\ cm^2$ illuminated uniformly with $100\ mN/cm^2$ has following parameters. $n = 15\%$, open circuit voltage $V_o = 0.7$ V, Fill factor $FF = 0.8$ and thickness is 200 μm. The average optical generation rate $(1/cm^3 - s)$ is _____
(A) $1.04 \times 10^{19}$
(B) $5.57 \times 10^{19}$
(C) $0.84 \times 10^{19}$
(D) $8.36 \times 10^{19}$

**38.** For one sided abrupt p-n junction whose depletion capacitance is 50 PF at reverse bias voltage of 0.2 V. The relation between $\left(\frac{1}{C_D}\right)^2$ and applied voltage V is shown in figure below.



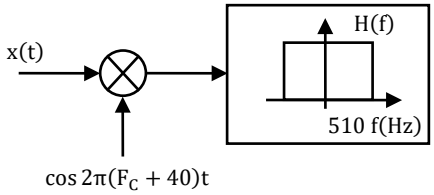

The slope of the line is _____

**39.** Let $S_{PM}(t) \notin S_{FM}(t)$ be time domain equations of phase modulation and frequency modulation as given below for the message m(t).
$S_{PM}(t) = \cos\left(1000\pi t + k_p\, m(t)\right)$
$S_{FM}(t) = \cos\left(1000\pi t + k_f \int_{-\infty}^{t} m(\tau)d\tau\right)$ where $k_p$ is in rad/sec and $k_f$ is in rad/sec/v. m(t) is as shown figure below




If instantaneous frequency is same for both then $(k_p/k_f)$ is _____sec.

**40.** For the modulated signal $x(t) = m(t)\cos 2\pi F_c t$ if message $m(t) = 4\cos(1000\,\pi t)$ and carrier frequency $F_C = 1$MHz. If the signal x(t) is passed through a demodulator as shown below, then output y(t) of demodulator is _____

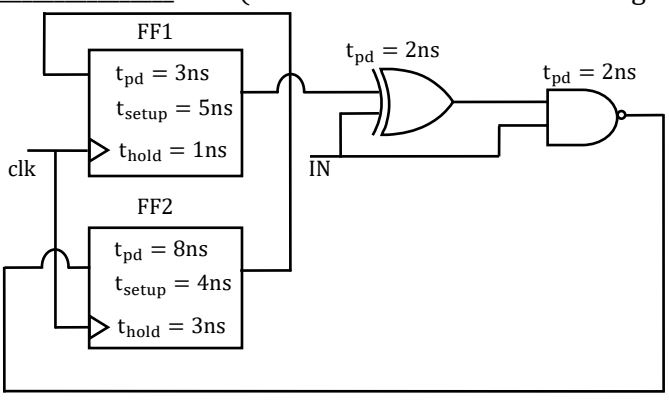



(A) $\cos(1000\,\pi t)$
(B) $\cos(920\,\pi t)$
(C) $\cos(460\,\pi t)$
(D) $\cos(540\,\pi t)$
**[Ans. B]**

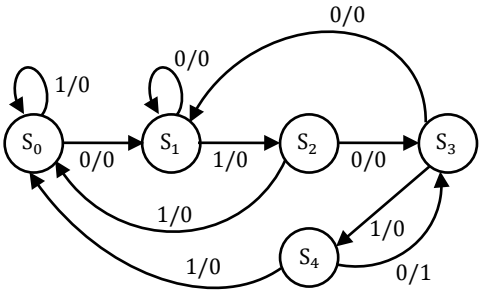
**41.** In digital communication system, a symbol chosen randomly $\{S_1, S_2, S_3, S_4\}$ is transmitted. It is given that $S_1 = -3, S_2 = -1, S_3 = 1$ and $S_4 = 2$. The received symbol is $Y = S + W$, where W is zero mean, unit variance Gaussian Random variable independent of $S_i$, $P_i$ is the probability of symbol error for maximum likelihood (MC) decoding. When transmitting $S = S + i$ the index I for which conditional symbol error probability ($P_i$) is the highest is _____.

**42.** P, Q, R are the decimal integers corresponding to 4-bit binary number 1100 considered in sign magnitude 1's compliment and 2's compliment representation respectively. The 6-bit 2's compliment representation of $P + Q + R$ is
(A) 1101016
(B) 110010
(C) 111101
(D) 111001
**[Ans. A]**

**43.** The maximum clock frequency at which the given circuit can operate reliably is _____MHz (rounded off to the nearest integer)

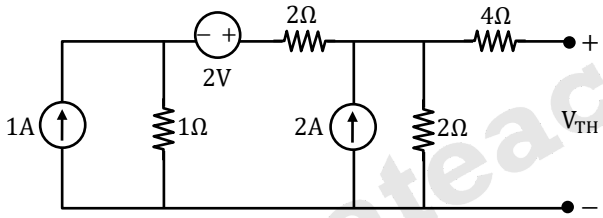


**44.** State diagram of a sequence detector is shown below. State, $S_0$ is the initial state of sequence detector. If the output is 1, then



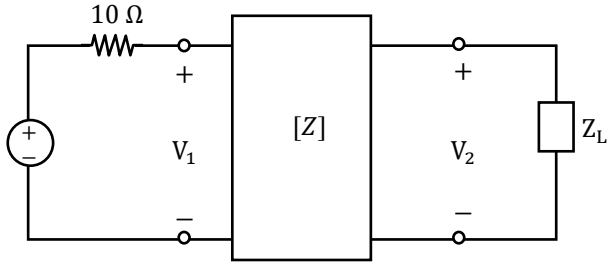

(A) the sequence 01001 is detected
(B) the sequence 01110 is detected
(C) the sequence 01011 is detected
(D) the sequence 01010 is detected
**[Ans. D]**

**45.** In the circuit shown below, Thevenin's voltage $V_{TH}$ is



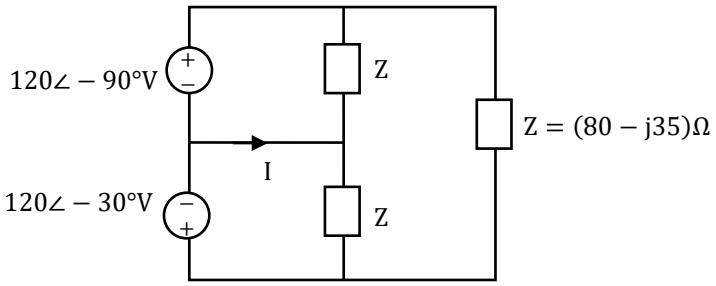

(A) 2.8 V
(B) 2.4 V
(C) 4.5 V
(D) 3.6 V
**[Ans. D]**

**46.** In the given circuit, the two-port network has impedance matrix $[Z] = \begin{bmatrix} 40 & 60 \\ 60 & 120 \end{bmatrix}$. The value of $Z_L$ for which maximum power is transferred to the load is _____ Ω




**[Ans. *] Range: 48 to 48**

**47.** The current I in the given network is




(A) $2.38\angle -23.63$ Amp
(B) $2.38\angle 143.63$ Amp
(C) $2.38\angle -96.37$ Amp
(D) 0 Amp

Will update soon

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