EC: ELECTRONICS AND COMMUNICATION ENGINEERING

EE25BTECH11037 - Divyansh

Q1. The order of differential equation $\frac{d^2y}{dt^2} + \left(\frac{dy}{dt}\right)^3 + y^4 = e^{-t}$ is

a) 1 b) 2 c) 3 d) 4

(GATE EC 2009)

Q2. The Fourier series of a real periodic function has only

P cosine terms if it is even
Q sine terms if it is even.
R cosine terms if it is odd.
S sine terms if it is odd.

Which of the following statements is are correct?

a) P and S b) P and R c) Q and S d) Q and R

(GATE EC 2009)

Q3. A function is given by $f(t) = \sin^2 t + \cos 2t$. Which of the following is true ?

a) f has frequency components at 0 and $1/2\pi$ Hz
b) f has frequency components at 0 and $1/\pi$ Hz
c) f has frequency components at $1/2\pi$ and $1/\pi Hz$
d) f has frequency components at 0, $1/2\pi$ and $1/\pi Hz$

(GATE EC 2009)

Q4. A fully charged mobile phone with a 12V battery is good for a 10 minute talk-time. Assume that, during the talk-time, the battery delivers a constant current of 2A and its voltage drops linearly from 12V to 10V as shown in Fig. 1. How much energy does the battery deliver during this talk-time ?

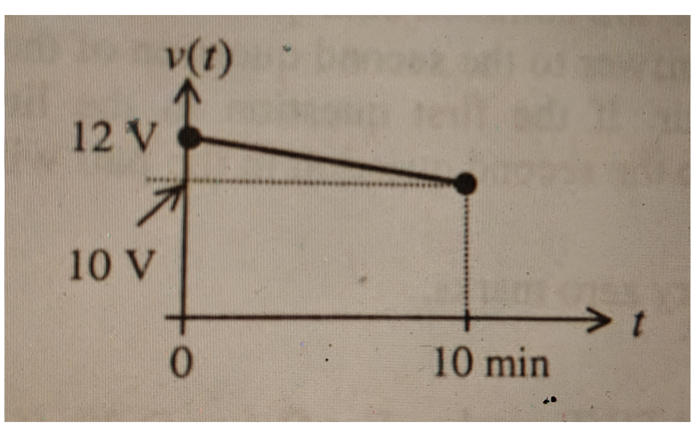

Fig. 1. v vs t graph

a) 220 J b) 12 kJ c) 13.2 kJ d) 14.4 kJ

(GATE EC 2009)

Q5. In an **n**-type silicon crystal at room temperature, which of the following can have a concentration of 4 x $10^{19} cm^{-3}$?

a) Silicon atoms b) Holes c) Dopant atoms d) Valence electrons

(GATE EC 2009)

Q6. The full form of abbreviations TTL and CMOS in reference to logic families are

a) Triple Transistor Logic and Chip Metal Oxide Semiconductor
b) Tristate Transistor Logic and Chip Metal Oxide Semiconductor
c) Transistor Transistor Logic and Complementary Metal Oxide Semiconductor
d) Tristate Transistor Logic and Complementary Metal Oxide Semiconductor

(GATE EC 2009)

Q7. The ROC of Z-tranform of the discrete time squence $x(n)$= $(\frac{1}{3})^n u(n)$ - $(\frac{1}{3})^n u(-n-1)$ is

a) $\frac{1}{3} < |z| < \frac{1}{2}$
b) $|z| > \frac{1}{2}$
c) $|z| < \frac{1}{3}$
d) $2 < |z| < 3$

(GATE EC 2009)

Q8. The magnitude plot of a rational transfer function $G(s)$ with real coefficients is shown below in the Fig. 2. Which of the following compensators has such a magnitude plot ?

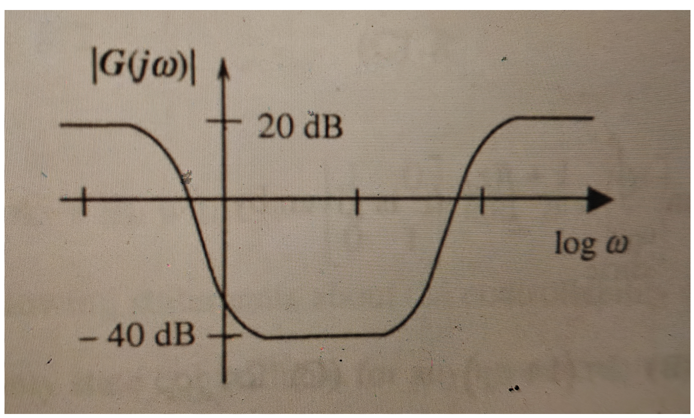

Fig. 2. Magnitude plot of function $G(s)$

a) Lead compensator
b) Lag compensator
c) PID compensator
d) Lead-lag compensator

(GATE EC 2009)

Q9. A white noise process $X(t)$ with two-sided power spectral density 1x $10^{-10} W/Hz$ is input into a filter whose magnitude squared response is shown below in the Fig. 3.

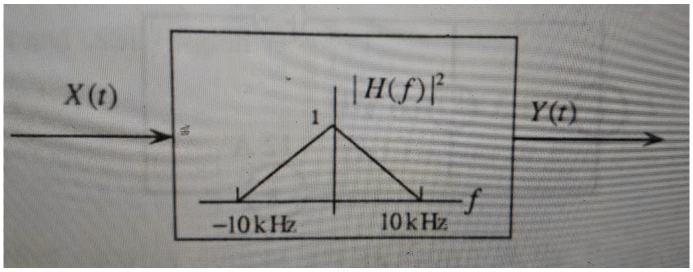

Fig. 3. for Q-9

The power output process $Y(t)$ is given by

a) 1 b) 2 c) 3 d) 4

(GATE EC 2009)

Q10. Which of the following statements is true regarding the fundamental node of the metallic waveguides shown in the $Fig.$ 4?

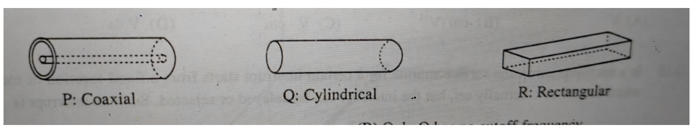

Fig. 4. for Q-10

a) Only P has no cutoff-frequency
b) Only Q has no cutoff-frequency
c) Only R has no cutoff-frequency
d) All three have cutoff-frequencies

(GATE EC 2009)

Q11. A fair coin is tossed 10 times. What is the probability that ONLY the first two will yield heads?

a) $\left(\frac{1}{2}\right)^2$ b) ${}^{10}C_2\left(\frac{1}{2}\right)^2$ c) $\left(\frac{1}{2}\right)^{10}$ d) ${}^{10}C_2\left(\frac{1}{2}\right)^{10}$

(GATE EC 2009)

Q12. If the power spectral density of stationary random process is a sine-squared function of frequency as shown in $Fig.$ 5, the shape of its autocorrelation is

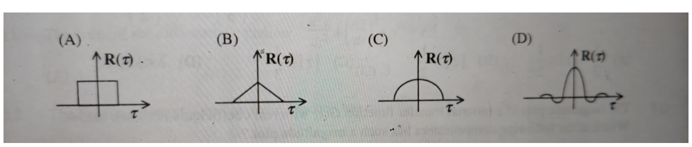

Fig. 5. for Q-12

(GATE EC 2009)

Q13. If $f(z) = c_0 + c_1 z^{-1}$, then $\oint_{unitcircle} \frac{1+f(z)}{z} dz$ is given by

a) $2\pi c_1$ b) $2\pi(1 + c_0)$ c) $2\pi j c_1$ d) $2\pi j(1 + c_0)$

(GATE EC 2009)

Q14. In the interconnection of ideal sources shown in $Fig.$ 6, it is known that the 60 V source is absorbing power.

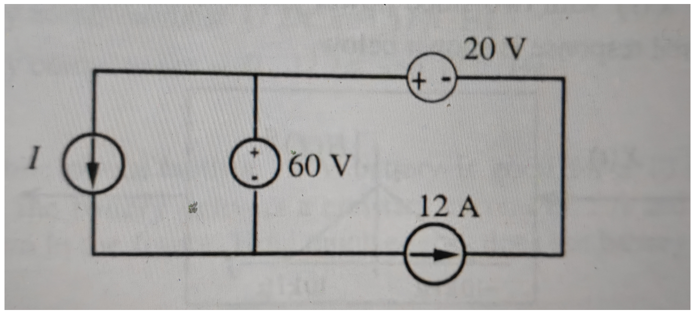

Fig. 6. Circuit for Q-14

Which of the following can the value of current source I ?

a) $10\ A$ b) $13\ A$ c) $15\ A$ d) $18\ A$

(GATE EC 2009)

Q15. The ratio of the mobility to the diffusion coefficient in a semiconductor has the units

a) V^{-1} b) $cm.V^{-1}$ c) $V.cm^{-1}$ d) $V.s$

(GATE EC 2009)

Q16. In a microprocessor, the service routine for a certain interrupt starts from a fixed location of a memory which cannot be externally set, but the interrupt can be delayed or rejected. Such an interrupt is

a) non-maskable and non-vectored
b) maskable and non-vectored
c) non-maskable and vectored
d) maskable and vectored

(GATE EC 2009)

Q17. If the transfer function of the following network is $\frac{V_o(s)}{V_i(s)} = \frac{1}{2+sCR}$, the value of load resistance R_L is

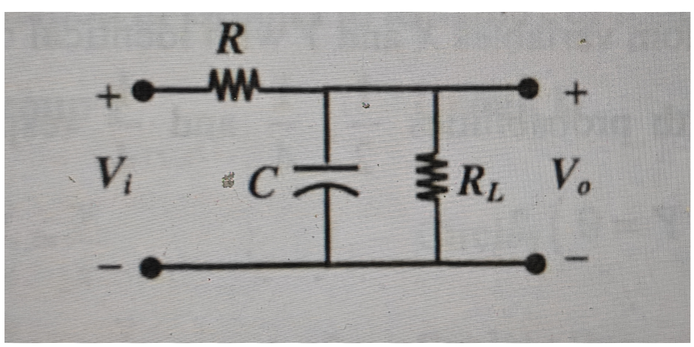

Fig. 7. Network for Q-17

a) R/4 b) R/2 c) R d) 2R

(GATE EC 2009)

Q18. Consider the system $\frac{dx}{dt} = Ax + Bu$ with $A = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ and B= $\begin{pmatrix} p \\ q \end{pmatrix}$ where p and q are arbitrary real numbers. Which of the following statements is true about the contrallability of the system is true?

a) The system is completely state controllable for any non zero values of p and q
b) Only $p = 0$ and $q = 0$ result in controllability

c) The system is uncontrollable for any values of p and q
d) We cannot conclude about controllability from the given data

(GATE EC 2009)

Q19. For a message signal $m(t) = \cos(2\pi f_m t)$ and the carrier of the frequency f_c, which of the following represent a single side band (SSB) signal?

a) $\cos(2\pi f_m t)\cos(2\pi f_c t)$
b) $\cos(2\pi f_c t)$
c) $\cos[2\pi(f_c + f_m)t]$
d) $[1 + \cos(2\pi f_m t)]\cos(2\pi f_c t)$

Q20. Two infinitely long wires carrying current are as shown in the $Fig.$ 8 below. One wire is in $y-z$ plane and parallel to the y-axis. The other wire is in the $x-y$ plane and parallel to the x-axis. Which components of the resulting magnetic fields are non-zero at origin?

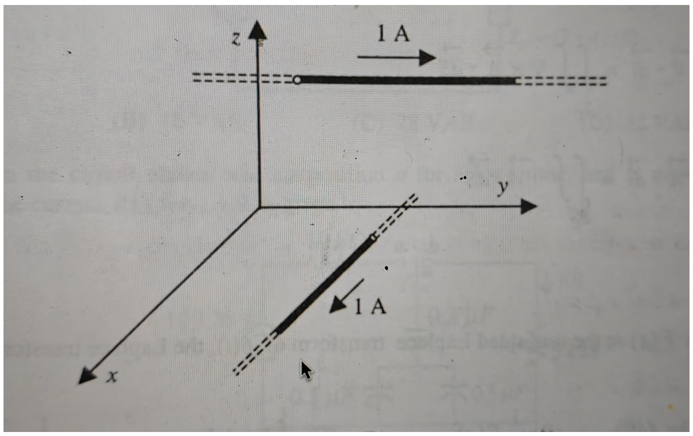

Fig. 8. For Q-20

a) x, y, z components
b) x, y components
c) y, z components
d) x, z components

(GATE EC 2009)

Q21. Consider two independent random variables X and Y with identical distributions. The variables X and Y take values 0, 1 and 2 with probabilities $\frac{1}{2}, \frac{1}{4} and \ \frac{1}{4}$ respectively. What is the conditional probability $P(X + Y = 2 \ | \ X - Y = 0)$?

a) 0
b) $\frac{1}{16}$
c) $\frac{1}{6}$
d) 1

(GATE EC 2009)

Q22. The Taylor series expansion of $\frac{\sin x}{x-\pi}$ at x=π is given by

a) 1+ $\frac{(x-\pi)^2}{3!}$ + ..
b) -1-$\frac{(x-\pi)^2}{3!}$ + ..
c) 1-$\frac{(x-\pi)^2}{3!}$ + ..
d) -1+ $\frac{(x-\pi)^2}{3!}$ + ..

(GATE EC 2009)

Q23. If a vector field $\mathbf{V}$ is related to another vector field $\mathbf{A}$ through $\mathbf{V} = \nabla$ x $\mathbf{A}$, which of the following is true? Note: C and S_c refer to any closed contour and any surface whose boundary is C.

a) $\oint_c \mathbf{V} \cdot \mathbf{dl} = \int_{S_c}\int \mathbf{A} \cdot \mathbf{dS}$
b) $\oint_c \mathbf{A} \cdot \mathbf{dl} = \int_{S_c}\int \mathbf{V} \cdot \mathbf{dS}$
c) $\oint_c \nabla \text{ x } \mathbf{V} \cdot \mathbf{dl} = \int_{S_c}\int \nabla \text{ x } \mathbf{A} \cdot \mathbf{dS}$
d) $\oint_c \nabla \text{ x } \mathbf{A} \cdot \mathbf{dl} = \int_{S_c}\int \mathbf{V} \cdot \mathbf{dS}$

(GATE EC 2009)

Q24. Given that $F(s))$ is the one-sided Laplace transform of $f(t))$, the Laplace transform of $\int_0^t f(\tau)\,d\tau$ is

a) $sF(s) - f(0)$
b) $\frac{1}{s}F(s)$
c) $\int_0^t F(\tau)\,d\tau$
d) $\frac{1}{s}[F(s) - f(0)]$

(GATE EC 2009)

Q25. Match each differential equation in Group I to its family of solution curves from Group II.

Group I	**Group II**
P. $\frac{dy}{dx} = \frac{y}{x}$	1. Circles
Q. $\frac{dy}{dx} = -\frac{y}{x}$	2. Straight lines
R. $\frac{dy}{dx} = \frac{x}{y}$	3. Hyperbolas
S. $\frac{dy}{dx} = -\frac{x}{y}$	

a) P-2,Q-3,R-3,S-1
b) P-1,Q-3,R-2,S-1
c) P-2,Q-1,R-3,S-3
d) P-3,Q-2,R-1,S-2

(GATE EC 2009)

Q26. The eigen values of the following matrix are $\begin{bmatrix} -1 & 3 & 5 \\ -3 & -1 & 6 \\ 0 & 0 & 3 \end{bmatrix}$

a) 3,3+5j,6-j
b) -6+5j,3+j, 3-j
c) 3+j, 3-j, 5+j
d) 3, -1+3j, -1-3j

(GATE EC 2009)

Q27. An AC source of RMS voltage with internal impedance $Z_s = (1 + 2j)\,\Omega$ feeds a load of impedance $Z_l = (7 + 4j)\,\Omega$ in the Fig. 9 below. The reactive power consumed by the load is

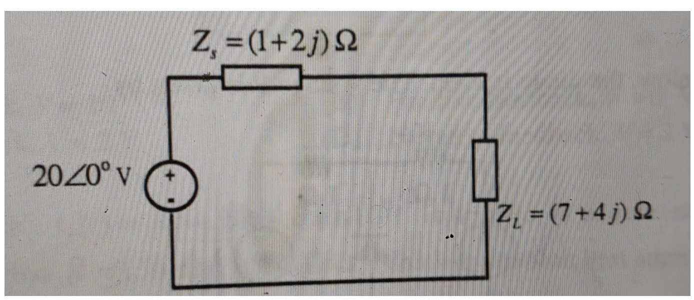

Fig. 9. Circuit for Q-27

a) 8 VAR
b) 16 VAR
c) 28 VAR
d) 32 VAR

(GATE EC 2009)

Q28. The switch in circuit shown was on a position a for a long time, and is moved to positon b at time t=0. The current $i(t)$ for $t > 0$ is given by

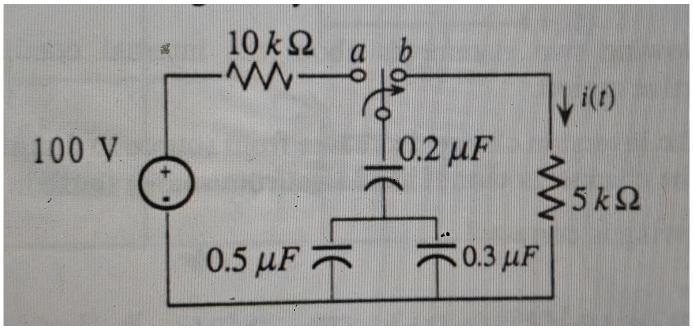

Fig. 10. Circuit for Q-28

a) $0.2e^{-125t}u(t) \quad mA$
b) $20e^{-1250t}u(t) \quad mA$
c) $0.2e^{-1250t}u(t) \quad mA$
d) $20e^{-1000t}u(t) \quad mA$

(GATE EC 2009)

Q29. In the Fig. 11 shown below, what value of R_l maximizes the power delivered to R_l ?

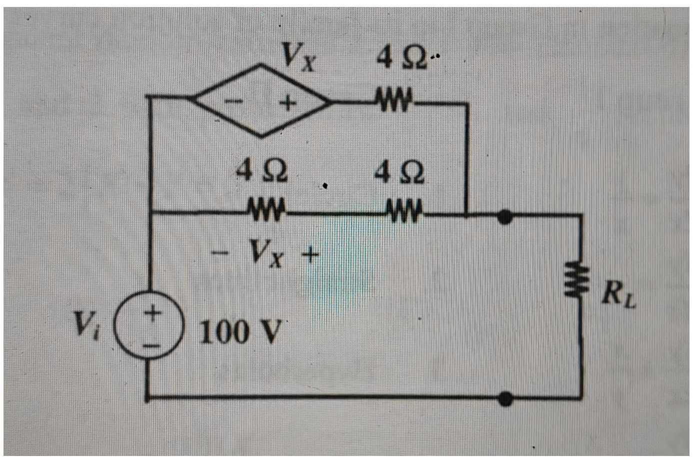

Fig. 11. Circuit for Q-29

a) 2.4Ω
b) $\frac{8}{3}\Omega$
c) 4Ω
d) 6Ω

(GATE EC 2009)

Q30. The time domain behavior of an RL circuit is represented by

$$L\frac{di}{dt} + Ri = V_0\left(1 + Be^{-\frac{Rt}{L}}\sin t\right)u(t)$$

For an intial current of $i(0) = \frac{V_o}{R}$, the steady state value of current is given by

a) 2.4Ω
b) $\frac{8}{3}\Omega$
c) 4Ω
d) 6Ω

(GATE EC 2009)

Q31. In the Fig. 12 below, the diode is ideal. The voltage V is given by

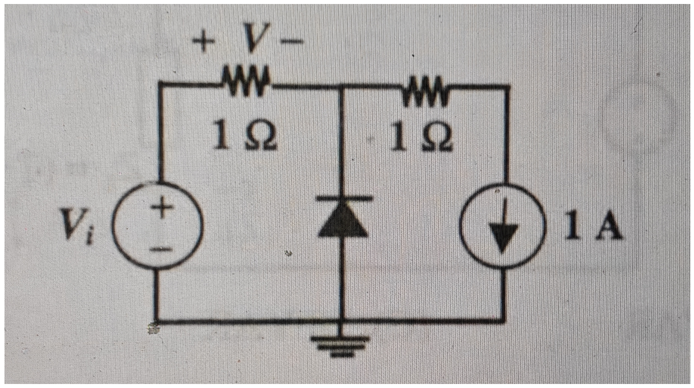

Fig. 12. Circuit for Q-31

a) $min(V_i, 1)$ b) $max(V_i, 1)$ c) $min(-V_i, 1)$ d) $max(-V_i, 1)$

(GATE EC 2009)

Q32. Consider the following two statements about the internal conditions in an n-channel MOSFET operating in the active region

S1: The inversion charge decreases from source to drain
S2: The channel potential increases from source to drain

Which of the following is correct?

a) Only S2 is true
b) Both S1 and S2 are false.
c) Both S1 and S2 are true, but S2 is not a reason for S1
d) Both S1 and S2 are true, but S2 is a reason for S1

(GATE EC 2009)

Q33. In the following astable multivibrator circuit, which properties of $v_o(t)$ depend on R_2 ?

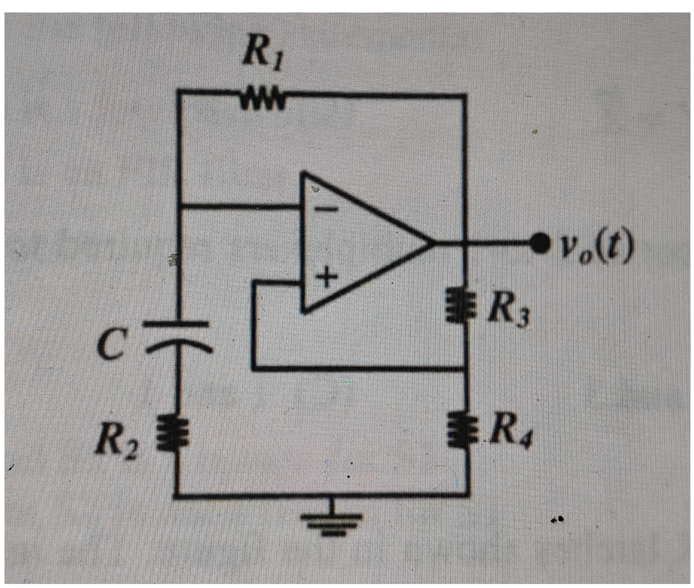

Fig. 13. Circuit for Q-33

a) Only the frequency
b) Only the amplitude
c) Both the amplitude and the frequency
d) Neither the amplitude and the frequency

(GATE EC 2009)

Q34. In the *Fig*. 14 shown below, the op-amp is ideal, the transistor has $V_{BE} = 0.6V$ and $\beta = 150$. Decide whether the feedback in the circuit is positive or negative and determine the voltage V at the output of op-amp.

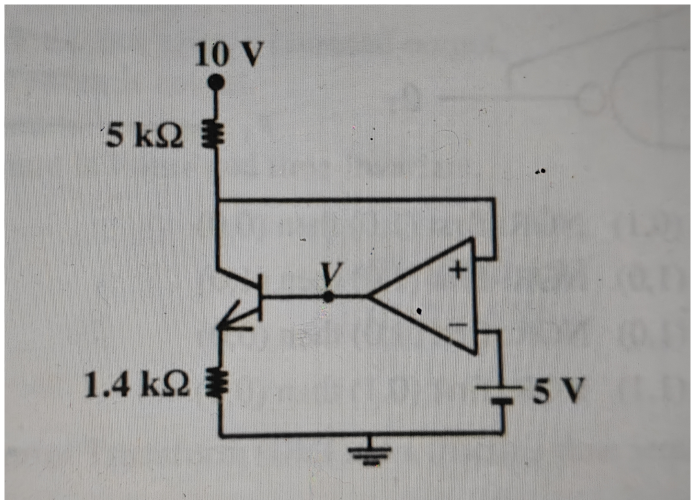

Fig. 14. Circuit for Q-34

a) Positive feedback, V=10V
b) Positive feedback, V=0V
c) Negative feedback, V=5V
d) Negative feedback, V=2V

(GATE EC 2009)

Q35. A small signal source $v_i(t) = A\cos 20t + B\sin 10^6 t$ is applied to a transistor amplifier as shown in the *Fig*. 15. The transistor has $\beta = 150$ and $h_{ie} = 3k\Omega$. Which expression best approximates $v_o(t)$?

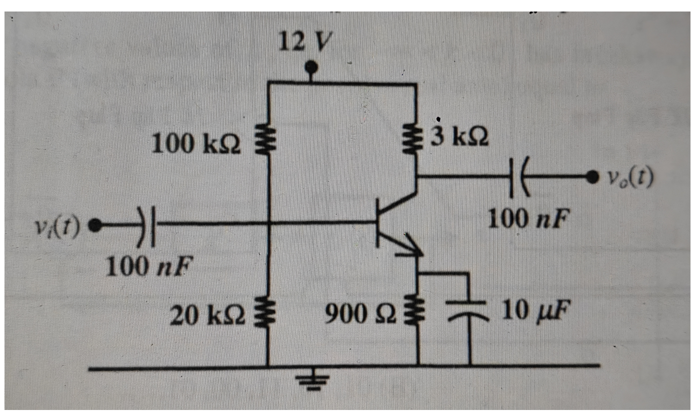

Fig. 15. Circuit for Q-35

a) $v_o(t) = -1500\left(A\cos 20t + B\sin 10^6 t\right)$
b) $v_o(t) = -150\left(A\cos 20t + B\sin 10^6 t\right)$
c) $v_o(t) = -1500B\sin 10^6 t$
d) $v_o(t) = -150B\sin 10^6 t$

(GATE EC 2009)

Q36. If $X = 1$ in the logic equation $\left[X + Z\left\{\overline{Y} + \left(\overline{Z} + X\overline{Y}\right)\right\}\right]\left\{\overline{X} + \overline{Z}(X+Y)\right\} = 1$, then

a) $Y = Z$ b) $Y = \overline{Z}$ c) $Z = 1$ d) $Z = 0$

(GATE EC 2009)

Q37. What are the minimum numbers of 2-to-1 multiplexers recquired to generate a 2-input AND gate and a 2-input Ex-OR gate ?

a) 1 and 2 b) 1 and 3 c) 1 and 1 d) 2 and 2

(GATE EC 2009)

Q38. Refer to NAND and NOR latches shown in the Fig. 16. The inputs (P_1, P_2) for both the latches are first made $(0, 1)$ and then, after a few seconds, made $(1, 1)$. The corresponding stable outputs (Q_1, Q_2) are

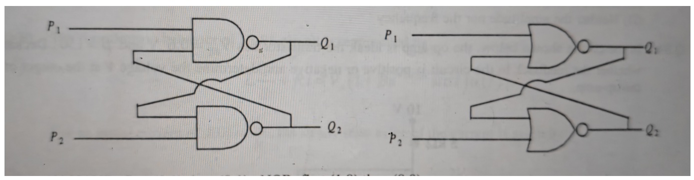

Fig. 16. NAND and NOR latches

a) NAND: first $(0, 1)$ then $(0, 1)$ NOR: first $(1, 0)$ then $(0, 0)$
b) NAND: first $(1, 0)$ then $(1, 0)$ NOR: first $(1, 0)$ then $(1, 0)$
c) NAND: first $(1, 0)$ then $(1, 0)$ NOR: first $(1, 0)$ then $(0, 0)$
d) NAND: first $(1, 0)$ then $(1, 1)$ NOR: first $(0, 1)$ then $(0, 1)$

(GATE EC 2009)

Q39. What are the counting states (Q_1, Q_2) for the counter shown in the firgure below ?

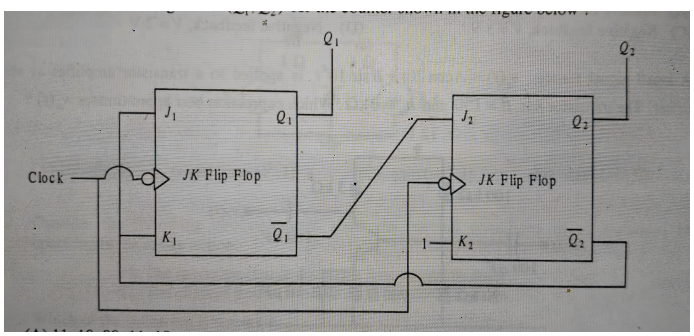

Fig. 17. Figure for Q-39

a) 11, 10, 00, 11, 10, ...
b) 01, 10, 11, 00, 01, ...
c) 00, 11, 01, 10, 00, ...
d) 01, 10, 00, 01, 10, ...

(GATE EC 2009)

Q40. A system with transfer function $H(z)$ has impulse response $h(.)$ defined as $h(2) = 1$, h(3)=-1 and h(k)=0 otherwise. Consider the following statements.

S2: H(z) is a FIR filter.

Which of the following is correct?

a) Only S2 is true
b) Both S1 and S2 are false.
c) Both S1 and S2 are true, but S2 is a reason for S1
d) Both S1 and S2 are true, but S2 is not a reason for S1

(GATE EC 2009)

Q41. Consider a system whose input x and output y are related by the equation

$$y(t) = \int_{-\infty}^{\infty} x(t-\tau)h(2\tau)d\tau$$

where h(t) is shown in the Fig. 18.

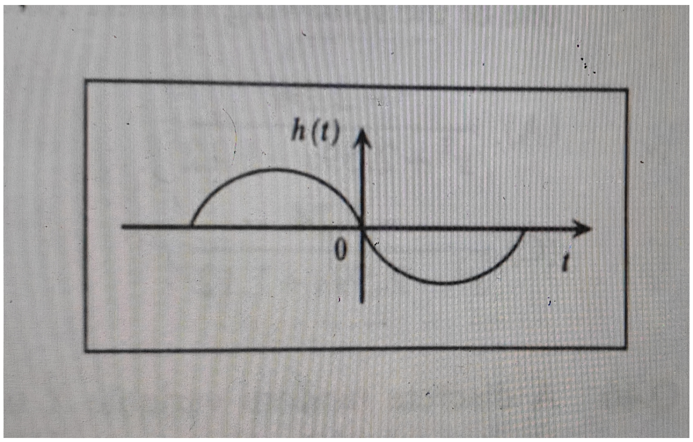

Fig. 18. Figure for Q-41

Which of the following four properties are possessed by the system?
BIBO: Bounded input gives a bounded output.
Casual: The system is casual.
LP: The system is low-pass
LTI: The system is linear and time-invariant.

a) Casual, LP
b) BIBO, LTI
c) BIBO, LTI, Casual
d) LP, LTI

(GATE EC 2009)

Q42. The 4-point Discrete Fourier Transform (DFT) of a discrete time sequence $\{1, 0, 2, 3\}$ is

a) $[0, -2+2j, 2, -2, -2j]$
b) $[2, 2+2j, 6, 2-2j]$
c) $[6, 1-3j, 2, 1+3j]$
d) $[6, -1+3j, 0, -1-3j]$

(GATE EC 2009)

Q43. The feedback configuration and pole-zero locations of $G(s) = \frac{s^2-2s+2}{s^2+2s+2}$ are shown below in the Fig. 19. The root locus for **negative** values of k, i.e. for $-\infty < k < 0$, has breakway/break-in points and angles of departure at pole **P** (with respect to the positive real axis) equal to

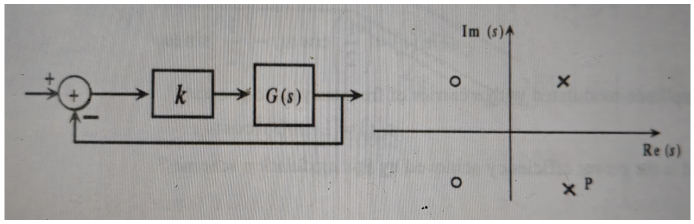

Fig. 19. Figure for Q-43

a) $\pm\sqrt{2}$ *and* 0° b) $\pm\sqrt{2}$ *and* 45° c) $\pm\sqrt{3}$ *and* 0° d) $\pm\sqrt{3}$ *and* 45°

(GATE EC 2009)

Q44. An LTI system having transfer function $\frac{s^2+1}{s^2+2s+1}$ and input $x(t) = \sin(t+1)$ is in steady state. The output is sampled at the rate $\omega_s rad/s$ to obtain the final output $\{y(k)\}$. Which of the following is true?

a) $y(\cdot)$ is zero for all sampling frequencies ω_s
b) $y(\cdot)$ is nonzero for all sampling frequencies ω_s
c) $y(\cdot)$ is nonzero for $\omega_s > 2$, but zero for $\omega_s < 2$
d) $y(\cdot)$ is zero for $\omega_s > 2$, but nonzero for $\omega_s < 2$

(GATE EC 2009)

Q45. The unit step response of an under-damped second order system has steady state value of -2. Which of the following transfer functions has these properties?

a) $\frac{-2.24}{s^2+2.59s+1.12}$
b) $\frac{-3.82}{s^2+1.91s+1.91}$
c) $\frac{-2.24}{s^2-2.59s+1.12}$
d) $\frac{-2.24}{s^2-1.91s+1.91}$

(GATE EC 2009)

Q46. A discrete random variable X takes values from 1 to 5 with probabilities as shown in the table. A student calculates the mean of X as 3.5 and her teacher calculates the variance pf X as 1.5 .Which of the following statements are true?

k	1	2	3	4	5
$P(X=k)$	0.1	0.2	0.4	0.2	0.1

a) Both the student and the teacher are right
b) Both the student and the teacher are wrong
c) The student is wrong but the teacher is right
d) The student is right but the teacher is wrong

(GATE EC 2009)

Q47. A message signal given by $m(t) = \left(\frac{1}{2}\right)\cos\omega_1 t - \left(\frac{1}{2}\right)\sin\omega_2 t$ is amplitude-modulated with a carrier of frequency ω_c to generate $s(t) = [1+m(t)]\cos\omega_c t$
What is the power efficiency achieved by this modulation scheme?

a) 8.33%
b) 11.11%
c) 20%
d) 25%

(GATE EC 2009)

Q48. A communication channel with AGWN operating at a signal to noise ratio $SNR >> 1$ and bandwidth B has capacity C_1. If SNR is doubled keeping B constant, the resulting capacity C_2 is given by

a) $C_2 \approx 2C_1$
b) $C_2 \approx C_1 + B$

c) $C_2 \approx C_1 + 2B$
d) $C_2 \approx C_1 + 0.3B$

(GATE EC 2009)

Q49. A magnetic field in air is measured to be $\mathbf{B} = B_0(\frac{x}{x^2+y^2}\hat{y} - \frac{y}{x^2+y^2}\hat{x})$
What current distribution leads to this field?
a) $\mathbf{J} = -\frac{B_o\hat{z}}{\mu_0}\left(\frac{1}{x^2+y^2}\right), r \neq 0$
b) $\mathbf{J} = -\frac{B_o\hat{z}}{\mu_0}\left(\frac{2}{x^2+y^2}\right), r \neq 0$
c) $\mathbf{J} = 0, r \neq 0$
d) $\mathbf{J} = \frac{B_o\hat{z}}{\mu_0}\left(\frac{1}{x^2+y^2}\right), r \neq 0$

(GATE EC 2009)

Q50. A transmission line terminates in two branches, each of lenght $\lambda/4$, as shown. The branches are terminated by 50Ω loads. The lines are lossless and have characteristic impedances shown in the Fig. 21. Determine the impedance Z_i as seen by the source.

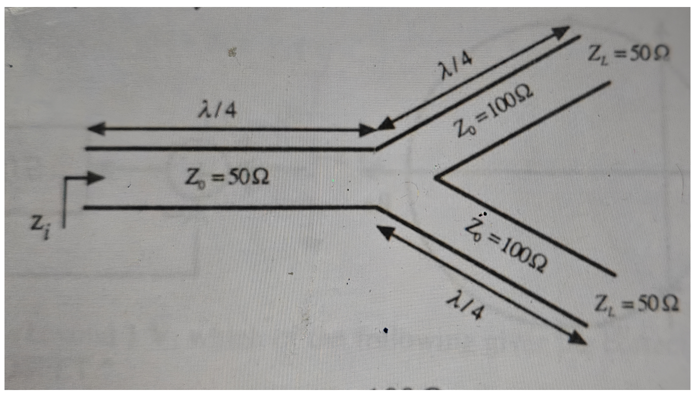

Fig. 20. Figure for Q-50

a) 200Ω
b) 100Ω
c) 50Ω
d) 25Ω

(GATE EC 2009)

Common Data Questions
for q51 and q52
Consider a silicon p-n junction at room temperature having the following parameters:
Doping on the n-side = $1x10^{17}cm^{-3}$
Depletion width on the n-side =$0.1\mu m$
Depletion width on the pride = $1.0\mu m$
Intrinsic carrier concentration = $1.4x10^{10}cm^{-3}$
Thermal voltage = 26 mV
Permittivity of free space =$8.85x10^{-14}F \cdot cm^{-1}$
Dielectric constant of silicon = 12

Q51. The built-in potential of the junction is

a) 0.70 V
b) 0.76 V
c) 0.82 V
d) cannot be estimated from the given data

(GATE EC 2009)

Q52. The peak electric field in the device is
a) $0.15MV \cdot cm^{-1}$, directed from p-region to n-region

b) $0.15 MV \cdot cm^{-1}$, directed from n-region to p-region
c) $1.80 MV \cdot cm^{-1}$, directed from p-region to n-region
d) $1.80 MV \cdot cm^{-1}$, directed from n-region to p-region

(GATE EC 2009)

for q53 and q54
The Nyquist plot of a stable transfer function $G(s)$ is shown in the figure. We are interested in the stability of closed loop system in the feedback configuration shown in the Fig. 21.

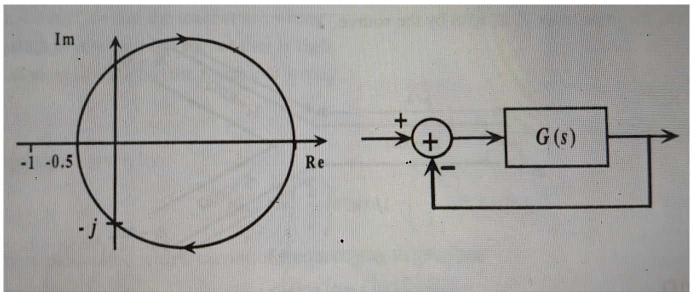

Fig. 21. Figure for Q-53 and Q-54

Q53. Which of the following is true ?

a) $G(s)$ is an all pass-filter
b) $G(s)$ has a zero in the right-half plane
c) $G(s)$ is the impedance of a passive network
d) $G(s)$ is marginally stable

(GATE EC 2009)

Q54. The gain and phase margins of $G(s)$ for closed loop stability are

a) 6 dB and 180°
b) 3 dB and 180°
c) 6 dB and 90°
d) 3 dB and 90°

(GATE EC 2009)

for q55 and q56
The amplitude of a **random** signal is uniformly distributed between -5V and 5V.

Q55. If the signal to quantization noise ratio required in uniformly quantizing the signal is 43.5 dB, the step size of the quantization is approximately

a) $0.0333V$
b) $0.05V$
c) $0.0667V$
d) $0.10V$

Q56. If the positive values of the signal are uniformly quantized with a step size of 0.05 V, and the negative values are uniformly quantized with a step size of 0.1 V, the resulting signal to quantization noise ratio is approximately

a) 46 dB
b) 43.8 dB
c) 42 dB
d) 40 dB

for q57 and q58
Consider the CMOS circuit shown in the Fig. 23, where the gate voltage v_c of the n-MOSFET is increased from zero, while the gate voltage of the p-MOSFET is kept constant at 3 V. Assume that, for both transistors, the magnitude of the threshold voltage is 1 V and the product of the transconductance parameter and the (W/L) ratio, i.e. the quantity $\mu C_{ox}(W/L)$, is 1 $mA \cdot V^{-2}$

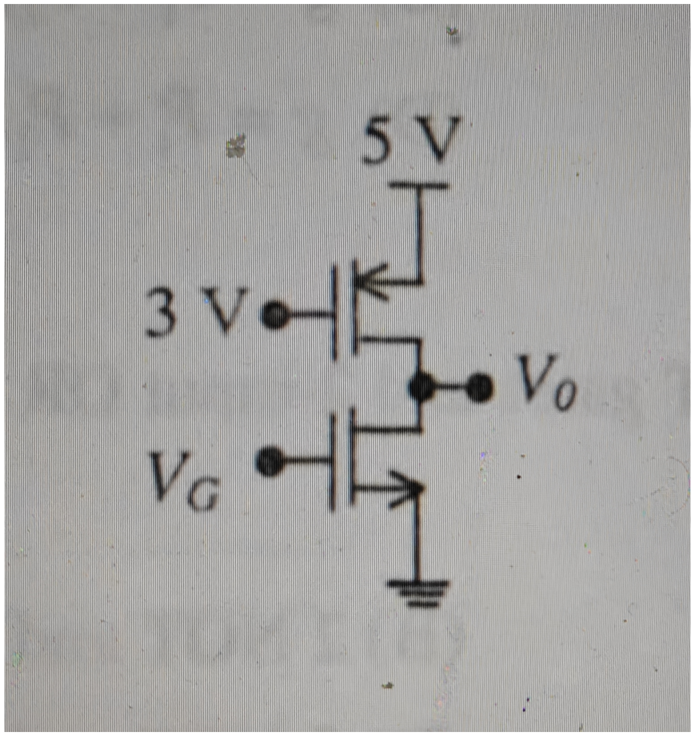

Fig. 22. Figure for Q-57 and Q-58

Q57. For small increase in V_G beyond 1 V, which of the following gives the correct description of the region of operation of each MOSFET ?

a) Both the MOSFETs are in saturation region
b) Both the MOSFETs are in triode region
c) n-MOSFET is in triode and p-MOSFET is in saturation region
d) n-MOSFET is in saturation and p-MOSFET is in triode region

Q58. Estimate the output voltage V_o for $V_G = 1.5$V.

a) $4 - \frac{1}{\sqrt{2}}$ b) $4 + \frac{1}{\sqrt{2}}$ c) $4 - \frac{\sqrt{3}}{2}$ d) $4 + \frac{\sqrt{3}}{2}$

(GATE EC 2009)

for q59 and q60

Two products are sold from a vending machine, which has two push buttons P_1 and P_2. When a button is pressed, the price of the corresponding product is displayed in a 7-segment display.

- If no buttons are pressed, '0' is displayed, signifying 'Rs. 0'.
- If only P_1 is pressed, '2' is displayed, signifying 'Rs. 2'.
- If only P_2 is pressed, '5' is displayed, signifying 'Rs. 5'.
- If both P_1 and P_2 is pressed, 'E' is displayed, signifying 'Error'.

The name of the segments in the 7-segment display, and the glow of the display for '0', '2', '5' and 'E', are shown below in the *Fig*. 23.

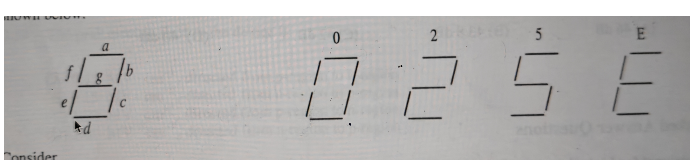

Fig. 23. Figure for Q-59 and Q-60

Consider

a) push button pressed/not pressed is equivalent to logic 1/10 respectively,
b) a segment glowing/not glowing in the display is equivalent to logic 1/0 respectively.

Q59. If the segment a to g are considered as functions of P_1 and P_2, then which of the following is correct?

a) g = $\overline{P_1} + P_2$, d=c+e
b) g = $P_1 + P_2$, d=c+e
c) g = $\overline{P_1} + P_2$, e=b+c
d) g = $P_1 + P_2$, e=b+c

(GATE EC 2009)

Q60. What are the minimum numbers of NOT gates and 2-input OR gates required to design the logic of the driver for this 7-segment display?

a) 3 NOT and 4 OR
b) 2 NOT and 4 OR
c) 1 NOT and 3 OR
d) 2 NOT and 3 OR

(GATE EC 2009)