ASSIGNMENT 2: GATE 2011 IN:INSTRUMENTATION ENGINEERING

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1) The matrix $\mathbf{M} = \begin{pmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{pmatrix}$ has eigenvalues -3, -3, 5. An eigenvector corresponding to the eigenvalue 5 is $\begin{pmatrix} 1 & 2 & -1 \end{pmatrix}$. One of the eigenvectors of the matrix M^3 is

a) $\begin{pmatrix} 1 & 8 & -1 \end{pmatrix}^T$ b) $\begin{pmatrix} 1 & 2 & -1 \end{pmatrix}^T$ c) $\begin{pmatrix} 1 & 2 & -1 \end{pmatrix}^T$ d) $\begin{pmatrix} 1 & 1 & -1 \end{pmatrix}^T$

(GATE IN 2011)

2) The contour integral $\oint_C e^{\frac{1}{z}} dz$, with C as the counter-clockwise unit circle in the z-plane, is equal to

a) 0 b) 2π c) $2\pi sqrt(-1)$ d) ∞

(GATE IN 2011)

3) Consider the signal $x(t) = e^t, t \geq 0; \quad x(t) = 0, t < 0$. Let $X(\omega)$ denote the Fourier transform of this signal. The integral $\frac{1}{2\pi} \int_{-\infty}^{\infty} X(\omega) d\omega$ is

a) 0 b) 1/2 c) 1 d) ∞

(GATE IN 2011)

4) The continuous-time signal $x(t) = \sin(\omega_0 t)$ is periodic signalever, for its discrete-time counterpart $x[n] = \sin(\omega_0 n)$ to be periodic, the necessary condition is

a) $0 \leq \omega_0 < 2\pi$
b) $\frac{2\pi}{\omega_0}$ must be an integer
c) $\frac{2\pi}{\omega_0}$ must be a rational number
d) none

(GATE IN 2011)

5) Consider a periodic signal $x(t)$

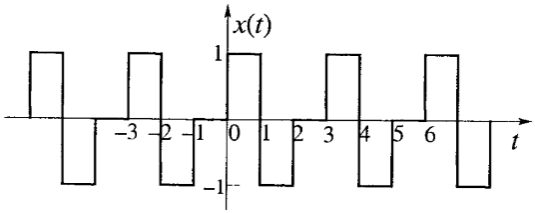

Fig. 5

with Fourier series representation $x(t) = \sum_{k=-\infty}^{\infty} a_k e^{j(2\pi/T)kt}$. Which one of the following statements is TRUE?

a) $a_k = 0$, for k odd integer and $T = 3$
b) $a_k = 0$, for k even integer and $T = 3$
c) $a_k = 0$, for k even integer and $T = 6$
d) $a_k = 0$, for k odd integer and $T = 6$

(GATE IN 2011)

6) The integral $\frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\infty} t^2 e^{-t^2/2} \delta(1 - 2t) dt$ is equal to

a) $\frac{1}{8\sqrt{2\pi}} e^{-1/8}$
b) $\frac{1}{4\sqrt{2\pi}} e^{-1/8}$
c) $\frac{1}{\sqrt{2\pi}} e^{-1/2}$
d) 1

(GATE IN 2011)

7) Shown below is the pole-zero plot of a digital filter.

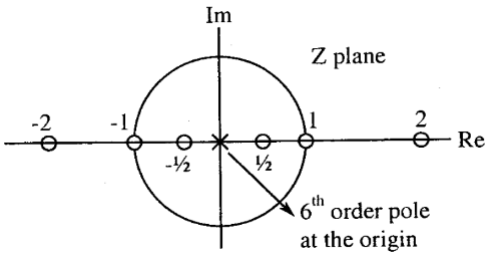

Fig. 7

Which one of the following statements is TRUE?

a) This is a low pass filter
b) This is a high pass filter
c) This is an IIR filter
d) This is an FIR filter

(GATE IN 2011)

8) The continuous time signal $x(t) = \cos(100\pi t) + \sin(300\pi t)$ is sampled at the rate 100 Hz to get the signal $x_s(t) = \sum_{n=-\infty}^{\infty} x(nT_s)\delta(t - nT_s)$, T_s = sampling period The signal $x_s(t)$ is passed through an ideal low pass filter with cutoff frequency 100 Hz. The output of the filter is proportional to

a) $\cos(100\pi t)$
b) $\cos(100\pi t) + \sin(100\pi t)$
c) $\cos(100\pi t) - \sin(100\pi t)$
d) $\sin(100\pi t)$

(GATE IN 2011)

9) Consider a system with input $x(t)$ and output $y(t)$ related as follows $y(t) = \frac{d}{dt}\left[e^{-t}x(t)\right]$ Which one of the following statements is TRUE?

a) The system is nonlinear
b) The system is time-invariant
c) The system is stable
d) The system has memory

(GATE IN 2011)

10) The first two rows of Routh's table of a third-order characteristic equation are:

s^3 3 3
s^2 4 4

It can be inferred that the system has

a) One real pole in the right-half of s-plane
b) A pair of complex conjugate poles in the right-half of s-plane
c) A pair of real poles symmetrically placed around $s = 0$
d) A pair of complex conjugate poles on the imaginary axis of the s-plane

(GATE IN 2011)

11) The amplifier shown has a voltage gain of -2.5, an input resistance of $10\,k\Omega$, and a lower 3-dB cut-off frequency of 20 Hz. Which one of the following statements is TRUE when the emitter resistance R_E is doubled?

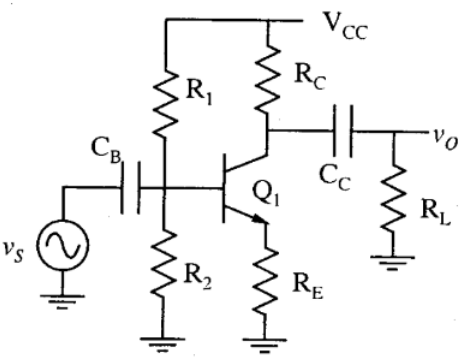

Fig. 11

a) Magnitude of voltage gain will decrease
b) Input resistance will decrease
c) Collector bias current will increase
d) Lower 3-dB cut-off frequency will increase

(GATE IN 2011)

12) Figure below shows a circuit for implementing an 8-bit Digital-to-Analog converter (DAC) using two identical 4-bit DACs with equal reference voltages. Assume that

b_0 represents LSB, b_7 MSB and the opamp is ideal. To obtain correct analog values corresponding to an 8-bit DAC at the output V_O, the value of resistor R is

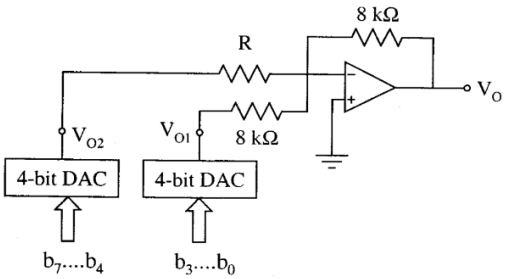

Fig. 12

a) 0.25 kΩ b) 0.5 kΩ c) 1 kΩ d) 8 kΩ

(GATE IN 2011)

13) In the circuit, the switch initially at position 1 for a long time is changed to position 2 at $t = 0$. The current $i(t)$ through the inductor for $t \geq 0$ is

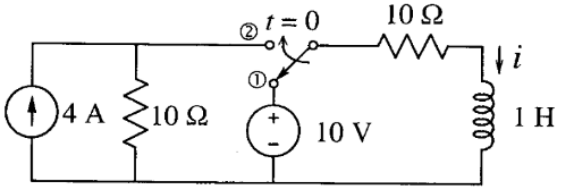

Fig. 13

a) $1 - e^{-20t}\,A$
b) $1 + e^{-20t}\,A$
c) $1 + 2e^{-20t}\,A$
d) $2 - e^{-20t}\,A$

(GATE IN 2011)

14) The current I shown in the circuit is equal to

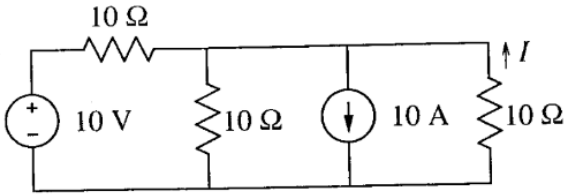

Fig. 14

a) $3\,A$ b) $3.67\,A$ c) $6\,A$ d) $9\,A$

(GATE IN 2011)

15) The transfer function $\frac{C}{R}$ of the system represented by the signal flow graph is

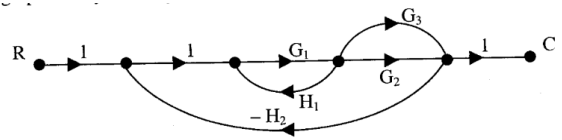

Fig. 15

a) $\frac{G_1G_2+G_1G_3}{1+G_1G_2H_2}$
b) $\frac{G_1G_2+G_1G_3}{1-G_1H_1+G_1G_2H_2}$
c) $\frac{G_1G_2+G_1G_3}{1-G_1H_1+G_1G_2H_2+G_1G_3H_2}$
d) $\frac{G_1G_2+G_1G_3}{1-G_1H_1+G_1G_2H_2+G_1G_3H_2+G_1G_2G_3H_1}$

(GATE IN 2011)

16) For the Boolean expression $f = |\overline{a}\overline{b}\overline{c} + \overline{a}b\overline{c} + \overline{a}\overline{b}c + a\overline{b}\overline{c} + abc$, the minimized Product of Sum (PoS) expression is

a) $(\overline{b} + \overline{c})(a + \overline{c})$
b) $(\overline{b} + c)(\overline{a} + c)$
c) $(\overline{b} + c)(a + \overline{c})$
d) $\overline{c} + abc$

(GATE IN 2011)

17) The base of the number system for the addition operation 24 + 14 = 41 to be true is

a) 8 b) 7 c) 6 d) 5

(GATE IN 2011)

18) An $8K\times8$ bit RAM is interfaced to an 8085 microprocessor. In a fully decoded scheme, if the address of the last memory location is 4FFFH, the address of the first memory location of RAM is

a) 1000H b) 2000H c) 3000H d) 4000H

(GATE IN 2011)

19) The Treadmill Test is used to diagnose

a) The balancing style during walk of the patient
b) The auditory activity of the patient
c) The visual activity of the patient
d) The cardiac activity of the patient

(GATE IN 2011)

20) The characteristics of a thermometer measuring ambient temperature is $2\frac{dT_i}{dt} + T_i - T_a = 0$, where T_i and T_a are indicated and ambient temperatures respectively,both in $^\circ C$. The -3 dB cut-off frequency is

a) $\frac{1}{2}Hz$ b) $\frac{1}{4\pi}Hz$ c) $1\,Hz$ d) $2\pi\,Hz$

(GATE IN 2011)

21) For a copper-constantan (Type T) thermocouple, the junction potential E (in μV) at 0°C is given by: $E = 38.740+3.3\times10^{-2}T^2+2.07\times10^{-4}T^3-2.2\times10^{-6}T^4+$higher order terms Assuming cold junction compensation, the sensitivity of the thermocouple at 100°C is approximately:

a) 45.34 μV/°C b) 42.75 μV/°C c) 38.74 μV/°C d) 0.06 μV/°C

(GATE IN 2011)

22) A furnace temperature is monitored from 50 m away. The transmitter has a range of 0–500°C and provides a 4–20 mA output. The temperature is determined from the voltage across a 500 Ω resistor in the loop. If the measured voltage is 4 V, the furnace temperature is:

a) 100 °C b) 125 °C c) 150 °C d) 200 °C

(GATE IN 2011)

23) The core/cladding index difference of a single-mode optical fiber is 0.01. The refractive index of the core material is 1.5. The maximum angle of acceptance of the fiber is approximately:

a) 17.5° b) 12.1° c) 8.6° d) 2.0°

(GATE IN 2011)

24) The conventional way of expressing vibration is in terms of:

a) Richter scale
b) Acceleration due to gravity
c) Speed of sound
d) Atmospheric pressure

(GATE IN 2011)

25) The primary and secondary key of an LVDT (stroke length ±50 mm) are connected to a 3 kHz sinusoidal source and a diode bridge-based phase-sensitive demodulator. The core remains static at 15 mm above the null position. The frequency of the voltage observed at the input of the low-pass filter is:

a) 1 kHz b) 1.5 kHz c) 3 kHz d) 6 kHz

(GATE IN 2011)

26) The series $\sum_{m=0}^{\infty}\frac{(x-1)^{2m}}{4^m}$ converges for:

a) $-2 < x < 2$ b) $-1 < x < 3$ c) $-3 < x < 1$ d) $x < 3$

(GATE IN 2011)

27) Consider the differential equation: $y'' + 2y' + y = 0, \quad y(0) = 1, \quad y(1) = 0$ The value of $y(2)$ is:

a) -1 b) $-e^{-1}$ c) $-e^{-2}$ d) $-e^{2}$

(GATE IN 2011)

28) Box 1 contains chips numbered 3, 6, 9, 12, 15. Box 2 contains chips numbered 6, 11, 16, 21, 26. One chip is drawn from each box and their numbers are multiplied. The probability that the product is even is:

a) $\frac{6}{25}$ b) $\frac{2}{5}$ c) $\frac{3}{5}$ d) $\frac{19}{25}$

(GATE IN 2011)

29) The extremum (minimum or maximum) point of a function $f(x)$ is to be determined by solving $\frac{df(x)}{dx} = 0$ using the Newton-Raphson method. Let $f(x) = x^3 - 6x$ and $x_0 = 1$ be the initial guess of x. The value of x after two iterations (x_2) is

a) 0.0141 b) 1.4142 c) 1.4167 d) 1.5000

(GATE IN 2011)

30) The unit-step response of a negative unity feedback system with open-loop transfer function $G(s) = \frac{6}{s+5}$ is:

a) $1 - e^{-5t}$ b) $6 - 6e^{-5t}$ c) $\frac{6}{5} - \frac{6}{5}e^{-5t}$ d) $\frac{6}{11} - \frac{6}{11}e^{-5t}$

(GATE IN 2011)

31) The transfer function of the system described by the state-space equations $\begin{pmatrix}\dot{x}_1\\ \dot{x}_2\end{pmatrix} = \begin{pmatrix}-4 & -1\\ -3 & -1\end{pmatrix}\begin{pmatrix}x_1\\ x_2\end{pmatrix} + \begin{pmatrix}1\\ 1\end{pmatrix}u, \mathbf{y} = \begin{pmatrix}10\end{pmatrix}\begin{pmatrix}x_1\\ x_2\end{pmatrix}$ is

a) $\frac{s}{s^2+5s+1}$ b) $\frac{2s}{s^2+5s+1}$ c) $\frac{3s}{s^2+5s+1}$ d) $\frac{4s}{s^2+5s+1}$

(GATE IN 2011)

32) Consider the second-order system with the characteristic equation $s(s+3)+K(s+5) = 0$ The complex portion of the root locus for $0 < K < \infty$ lies on a circle. The two breakaway points on the real axis are:

a) $-5 \pm \frac{\sqrt{5}}{2}$ b) $-5 \pm \sqrt{5}$ c) $-5 \pm \sqrt{10}$ d) $-5 \pm 2\sqrt{5}$

(GATE IN 2011)

33) In a flapper-nozzle displacement transducer, the following parameters are given: Diameter of orifice = 0.2 mm, Diameter of nozzle = 0.8 mm, Supply pressure = 1.4×10^2 kPa (gauge), Ambient pressure = 0 (gauge). The maximum value of sensitivity is:

a) 4.0 MPa/mm b) 5.6 MPa/mm c) 6.4 MPa/mm d) 7.3 MPa/mm

(GATE IN 2011)

34) A differential push-pull type capacitive displacement sensor (nominal capacitance C_0 = 0.01 μF) is connected in two adjacent arms of an AC bridge in such a way that output voltage of bridge is independent of frequency of supply voltage. Supply to the bridge is 1 V at 1 kHz, and two equal resistances R = 3.9 kΩ are placed in the other arms. The bridge sensitivity is:

a) 0.001 mV/pF b) 0.05 mV/pF c) 0.1 mV/pF d) 0.5 mV/pF

(GATE IN 2011)

35) A turbine flowmeter is rotating at 72 rpm. The flux $\Psi(\theta)$ linked to the nearby magnet and coil assembly is given by $\Psi(\theta) = 3+\cos(4\theta)$ mWb, where θ is the angular position (in radians). The amplitude and frequency of the output voltage signal are:

a) 4 mV and 45.8 Hz
b) 30.2 mV and 4.8 Hz
c) 30.2 mV and 30.2 Hz
d) 288 mV and 45.8 Hz

(GATE IN 2011)

36) Assuming base-emitter voltage of 0.7 V and β = 99 for transistor Q_1, the output voltage V_o in the ideal opamp circuit is:

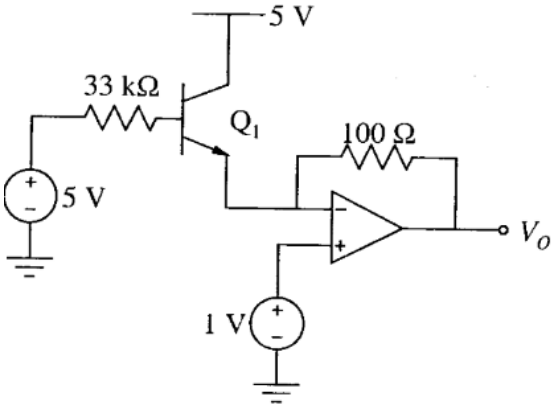

Fig. 36

a) -1 V b) $-\frac{1}{3.3}$ V c) 0 V d) 2 V

(GATE IN 2011)

37) Assuming zener diode D_1 has the I-V characteristics shown and forward voltage drop of diode D_2 is 0.7 V, the voltage V_o in the circuit is:

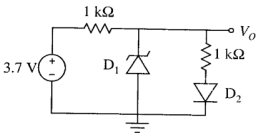

Fig. 37

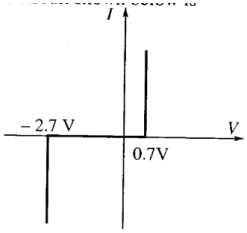

Fig. 37

a) 3.7 V b) 2.7 V c) 2.2 V d) 0 V

(GATE IN 2011)

38) The transfer characteristics of the circuit are observed on an oscilloscope in XY mode. V_i is connected to X input (0.5 V/div), V_o to Y input (2 V/div). The beam is at origin when $V_i = 0$.

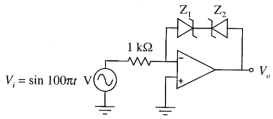

Fig. 38

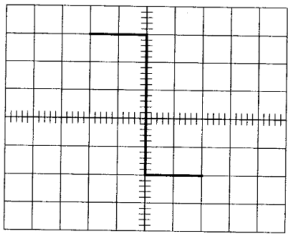

Fig. 38

Assuming ideal opamp and zener diodes with 0.7 V forward drop, the reverse breakdown voltages of Z_1 and Z_2 are:

a) 3.3 V and 5.3 V b) 4.7 V and 6.7 V c) 6.7 V and 4.7 V d) 5.3 V and 3.3 V

(GATE IN 2011)

39) Power in a three-phase star-connected balanced inductive load is measured by two-wattmeter method. Phase voltage = 230 V, Phase current = 5 A, Power factor = 0.707. The readings P_1 and P_2 of the two wattmeters are:

a) $P_1 = 298$ W, $P_2 = 1111$ W
b) $P_1 = 516$ W, $P_2 = 1924$ W
c) $P_1 = 1220$ W, $P_2 = 1220$ W
d) $P_1 = 1111$ W, $P_2 = -516$ W

(GATE IN 2011)

40) In the Wheatstone bridge shown, when resistance R_1 increases by $1\,\Omega$, the current through the galvanometer is:

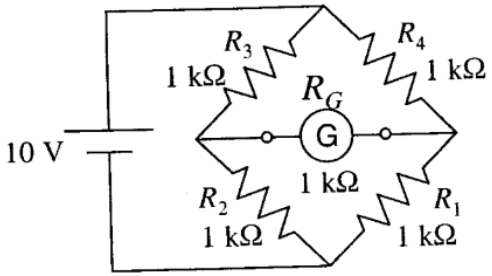

Fig. 40

(consider the Thevenin equivalent resistance of the bridge in the calculations)

a) 1.25 μA b) 2.5 μA c) 12.5 μA d) 25 μA

(GATE IN 2011)

41) The value of V_o of the series regulator shown below is:

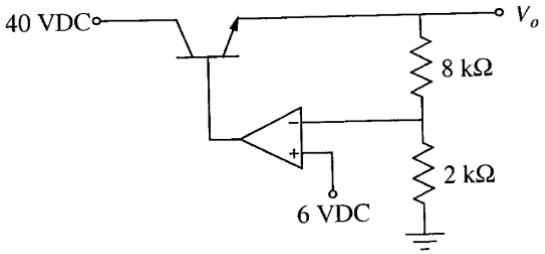

Fig. 41

a) 24 V b) 28 V c) 30 V d) 32 V

(GATE IN 2011)

42) The ideal opamp-based circuit shown below acts as a:

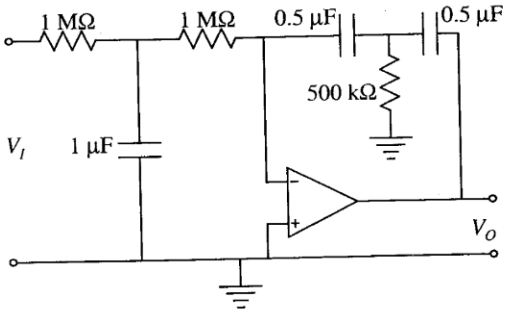

Fig. 42

a) Low-pass filter b) High-pass filter c) Band-pass filter d) Band-reject filter

(GATE IN 2011)

43) A 4-bit successive approximation type of A/D converter has an input range of 0 to 15 volts. The output bit b_1 next to the LSB has a stuck-at-zero fault. The pair of input voltages that produces the same output code word is:

a) 2 V and 4 V b) 4 V and 6 V c) 1 V and 2 V d) 8 V and 9 V

(GATE IN 2011)

44) The number of objects crossing a window sequentially at variable speed is to be counted using an interrupt in the 8085 microprocessor. The objects are sensed by an optical source and detector. The output is logic high while the object is in front of the window and this output is used to interrupt the detector. The duration ranges from 100 ms to 2 s. The processor takes 1 ms to process the input. The best choice of interrupt for error-free counting is:

a) RST 5.5 b) RST 6.5 c) RST 7.5 d) INTR

(GATE IN 2011)

45) The circuit below shows an up/down counter working with a decoder and a flip-flop.Preset and Clear of the flip-flop are asynchronous active-low inputs.Assuming that the initial value of counter output ($Q_2Q_1Q_0$) as zero,the counter outputs in decimal for 12 clock cycles are

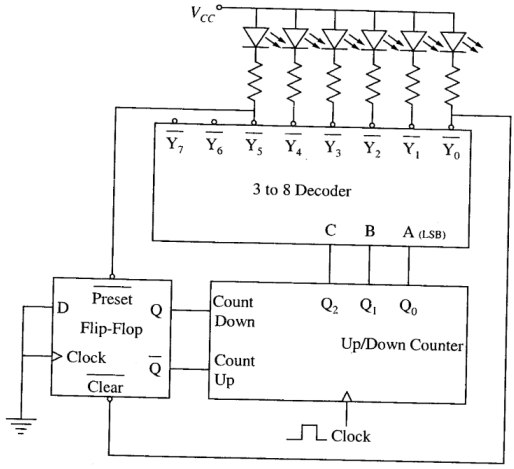

Fig. 45

a) 0,1,2,3,4,4,3,2,1,1,2,3,4
b) 0,1,2,3,4,5,0,1,2,3,4,5,0
c) 0,1,2,3,4,5,5,4,3,2,1,0,1

d) 0,1,2,3,4,5,4,3,2,1,0,1,2

(GATE IN 2011)

46) A square wave (amplitude ±10 mV, frequency 5 kHz, duty cycle 50%) is passed through an ideal low-pass filter with 0 dB gain and cutoff frequency 10 kHz. The filtered signal is buried in zero-mean noise with one-sided PSD of 25 pW/Hz up to 2 MHz. The signal-to-noise ratio of the output is:

a) 0 dB b) 0.1 dB c) 1.0 dB d) 3 dB

(GATE IN 2011)

47) Consider the difference equation $y[n] - \frac{1}{3}y[n-1] = x[n]$ and suppose that $x[n] = \left(\frac{1}{2}\right)^n u[n]$. Assuming the condition of initial rest, the solution for $y[n]$, $n \geq 0$ is

a) $3\left(\frac{1}{3}\right)^n - 2\left(\frac{1}{2}\right)^n$ b) $-2\left(\frac{1}{3}\right)^n + 3\left(\frac{1}{2}\right)^n$ c) $\frac{2}{3}\left(\frac{1}{3}\right)^n + \frac{1}{3}\left(\frac{1}{2}\right)^n$ d) $\frac{1}{3}\left(\frac{1}{3}\right)^n + \frac{2}{3}\left(\frac{1}{2}\right)^n$

(GATE IN 2011)

Common Data Questions

Common Data for Q48 and Q49 Consider the circuit given below

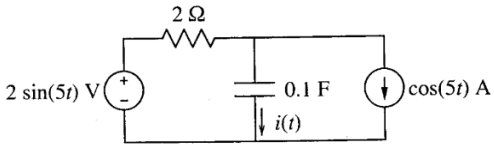

Fig. 47

48) The current $i(t)$ through the capacitor is:

a) $\sin(5t)$ A b) $\cos(5t)$ A c) $\sin(5t - 45°)$ A d) 1 A

(GATE IN 2011)

49) The average total power delivered by the two sources in the above circuit is:

a) 0 W b) 0.5 W c) 2 W d) 4 W

(GATE IN 2011)

Common Data for Q50 and Q51 The open-loop transfer function of a unity negative feedback control system is given by $G(s) = \dfrac{K(s+5)^3}{s^3}$

50) The value of K for the phase margin of the system to be 45° is:

a) $250\sqrt{5}$ b) $250\sqrt{2}$ c) $125\sqrt{5}$ d) $125\sqrt{2}$

(GATE IN 2011)

51) For the same system, the value of K for the damping ratio $\zeta = 0.5$ corresponding to the dominant closed-loop complex conjugate pole pair is:

a) 250 b) 125 c) 75 d) 50

(GATE IN 2011)

Common Data for Q52 and Q53 The level of water, stored in a truncated conical bath, is measured by a gamma-ray radiation sensor. The initial level of water is 1 m, and the level is increasing due to water inflow at the constant rate of $0.125 m^3/s$. Assume mass absorption coefficient of water is $77 \times 10^{-4} m^2/kg$ and density of water is $1000 kg/m^3$.

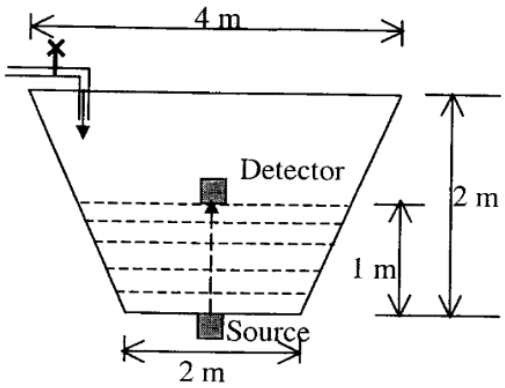

Fig. 51

52) When the intensity of radiation received by the floating detector is half of the intensity detected initially, the level of water is

a) 1.09 m b) 1.5 m c) 1.8 m d) 1.9 m

(GATE IN 2011)

53) When the floating detector is at the level calculated in Q.52, the time elapsed is

a) 4.1 s b) 5.23 s c) 10.52 s d) 50.63 s

(GATE IN 2011)

Common Data for Q54 and Q55 M1, M2 and M3 in the circuit shown below are matched N-channel enhancement mode MOSFETs operating in saturation mode, forward voltage drop of each diode is 0.7 V, reverse leakage current of each diode is negligible and the opamp is ideal.

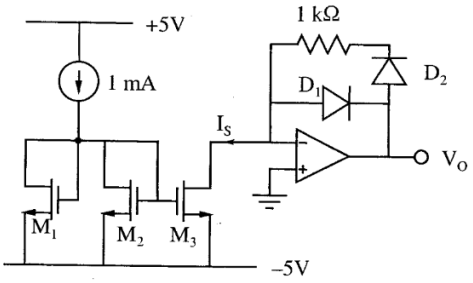

Fig. 53

54) The current I_S in the circuit is

a) -1 mA b) 0.5 mA c) 1 mA d) 2 mA

(GATE IN 2011)

55) For the computed value of current I_S, the output voltage V_O is

a) 1.2 V b) 0.7 V c) 0.2 V d) -0.7 V

(GATE IN 2011) **General Aptitude (GA) Questions**

56) There are two candidates P and Q in an election. During the campaign, 40% of the voters promised to vote for P, and rest for Q. However, on the day of election 15% of the voters went back on their promise to vote for P and instead voted for Q. 25% of the voters went back on their promise to vote for Q and instead voted for P. Suppose, P lost by 2 votes, then what was the total number of voters?

a) 100 b) 110 c) 90 d) 95

(GATE IN 2011)

57) The question below consists of a pair of related words followed by four pairs of words. Select the pair that best expresses the relation in the original pair:
Gladiator : Arena

a) dancer : stage
b) commuter : train
c) teacher : classroom
d) lawyer : courtroom

(GATE IN 2011)

58) Choose the most appropriate word from the options given below to complete the following sentence:
Under ethical guidelines recently adopted by the Indian Medical Association, human genes are to be manipulated only to correct diseases for which _____ treatments are unsatisfactory.

a) similar

b) most
c) uncommon
d) available

(GATE IN 2011)

59) Choose the word from the options given below that is most nearly opposite in meaning to the given word:

Frequency

a) periodicity
b) rarity
c) gradualness
d) persistency

(GATE IN 2011)

60) Choose the most appropriate word from the options given below to complete the following sentence:

It was her view that the country's problems had been _ _ _ _ _ _ _ _ by foreign technocrats, so that to invite them to come back would be counter-productive.

a) identified
b) ascertained
c) exacerbated
d) analysed

(GATE IN 2011)

61) The fuel consumed by a motorcycle during a journey while traveling at various speeds is indicated in the graph below.

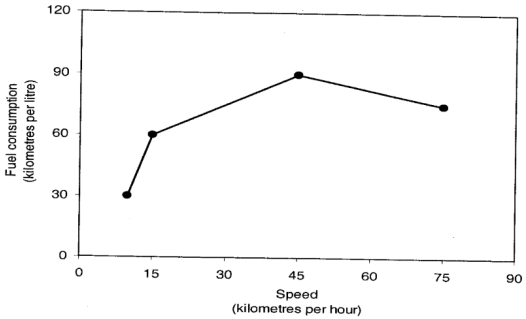

Fig. 61

The distances covered during four laps of the journey are listed in the table below

Lap	Distance (kilometres)	Average speed (kilometres per hour)
P	15	15
Q	75	45
R	40	75
S	10	10

TABLE 61

From the given data, we can conclude that the fuel consumed per kilometre was least during the lap

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

(GATE IN 2011)

62) **The horse has played a little known but very important role in the field of medicine. Horses were injected with toxins of diseases until their blood built up immunities. Then a serum was made from their blood. Serums to fight with diphtheria and tetanus were developed this way. It can be inferred from the passage, that horses were**

a) given immunity to diseases
b) generally quite immune to diseases
c) given medicines to fight toxins
d) given diphtheria and tetanus serums

(GATE IN 2011)

63) The sum of n terms of the series $4 + 44 + 444 + \ldots$ is

a) $\frac{4}{81}[10^{n+1} - 9n - 1]$
b) $\frac{4}{81}[10^{n-1} - 9n - 1]$
c) $\frac{4}{81}[10^{n+1} - 9n - 10]$
d) $\frac{4}{81}[10^{n} - 9n - 10]$

(GATE IN 2011)

64) Given that $f(y) = |y|/y$, and q is any non-zero real number, the value of $|f(q) - f(-q)|$ is

a) 0 b) -1 c) 1 d) 2

(GATE IN 2011)

65) Three friends, R, S and T shared toffee from a bowl. R took $1/3^{rd}$ of the toffees, but returned four to the bowl. S took $1/4^{th}$ of what was left but returned three toffees to the bowl. T took half of the remainder but returned two back into the bowl. If the bowl had 17 toffees left, how many toffees were originally there in the bowl?

a) 38 b) 31 c) 48 d) 41

(GATE IN 2011)