

Q. 1 – 30 Carry One Mark Each

1. A large number of $230\ \Omega$ resistors are obtained by combining $120\ \Omega$ resistors with a standard deviation of $4.0\ \Omega$ and $110\ \Omega$ resistors with a standard deviation of $3.0\ \Omega$. The standard deviation of the $230\ \Omega$ resistors thus formed will be
- (A) $3.5\ \Omega$ (C) $7.0\ \Omega$
(B) $5.0\ \Omega$ (D) $12.0\ \Omega$
2. A $3\ \frac{1}{2}$ digit multimeter has an accuracy specification of ($\pm 0.5\%$ of reading ± 5 counts). If the meter reads $2.00\ \text{mA}$ on a full scale of $20\ \text{mA}$, the worst-case error in the reading is
- (A) 0.5% (C) 3.0%
(B) 2.5% (D) 5.5%
3. Which one of the following is a derived unit (NOT a basic unit) in SI system?
- (A) Candela (C) Kelvin
(B) Coulomb (D) mol.
4. A shaft encoder attached to a dc motor has a sensitivity of 500 pulses per revolution. A frequency meter connected to the output of the encoder indicates the frequency to be $5500\ \text{Hz}$. The speed of the motor in RPM is
- (A) 110 (C) 550
(B) 220 (D) 660
5. A Pirani gage sensor is used to measure pressure of the order of
- (A) $10\ \text{MPa}$ (C) $100\ \text{Pa}$
(B) $1\ \text{MPa}$ (D) $1\ \text{Pa}$
6. Which of the following flow meters has the lowest pressure drop for a given range of flow?
- (A) Orifice meter (C) Flow Nozzle
(B) Venturi meter (D) Rotameter
7. Different types of transducers and signal conditioning circuits are given below. Match the transducer with the appropriate signal conditioning circuit commonly used with it.
- | | |
|------------------------|------------------------------|
| P Thermocouple | 1 DC Bridge |
| Q Strain gage | 2 Phase sensitive detector |
| R Piezoelectric sensor | 3 Charge amplifier |
| S L.V.D.T. | 4 Cold junction compensation |
| | 5 Instrumentation amplifier |

- (A) $P - 2, Q - 3, R - 5, S - 1$ (C) $P - 4, Q - 1, R - 2, S - 5$
 (B) $P - 1, Q - 5, R - 2, S - 3$ (D) $P - 4, Q - 1, R - 3, S - 2$

8. An integrator circuit is shown in Fig. Q.8 The opamp is of type 741 and has an input offset current i_{os} of $1 \mu\text{A}$. C is $1 \mu\text{F}$ and R is $1\text{M}\Omega$. If the input V_i is a 1 kHz square wave of 1 V peak to peak, the out put V_o , under steady state condition, will be

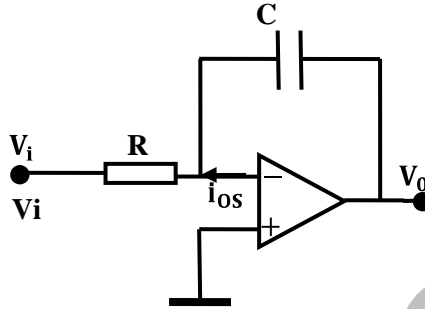


Fig. Q. 8

- (A) a square wave of 1 V peak to peak (C) positive supply voltage $+V_{cc}$
 (B) a triangular wave of 1 V peak to peak (D) negative supply voltage $-V_{cc}$
9. The out put of an opamp whose input is a 2.5 MHz square wave is shown in Fig. Q. 9. The slew rate of the opamp is

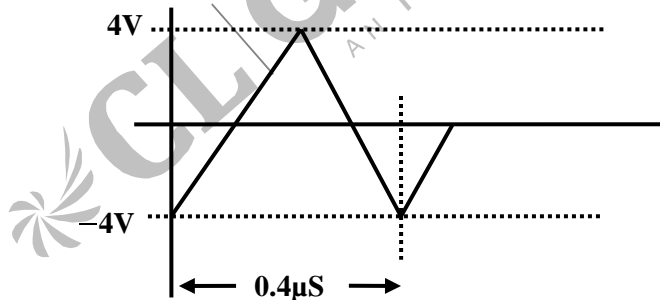


Fig. Q. 9

- (A) $0.8 \text{ V}/\mu\text{s}$ (C) $20.0 \text{ V}/\mu\text{s}$
 (B) $8.0 \text{ V}/\mu\text{s}$ (D) $40.0 \text{ V}/\mu\text{s}$
10. The opamp and the 1 mA current source in the circuit of Fig. Q.10 are ideal. The out put of the opamp is

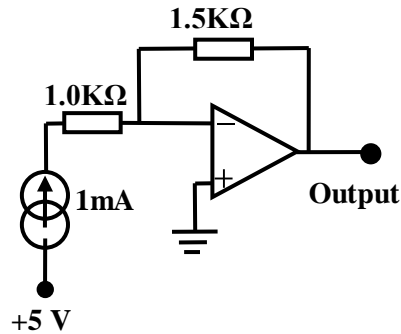


Fig. Q. 10

- (A) -1.5 mA (C) -7.5V
 (B) -1.5 V (D) $+1.5\text{V}$
11. Introducing a schottky diode between the base and collector of the output transistor in a TTL circuit
- (A) increases the speed of operation by inhibiting saturation
 (B) decreases the speed of operation by inhibiting saturation
 (C) increases the FAN OUT by enabling saturation
 (D) increases the speed of operation by enabling saturation
12. The Karnaugh map for a four variable Boolean function is given in Fig. Q.12. The correct Boolean sum of product is

PQ \ RS	00	01	11	10
00	0	0	0	0
01	1	0	0	1
11	1	0	0	1
10	0	1	0	0

Fig. Q. 12

- (A) $PQRS + \bar{Q}\bar{S}$ (C) $PQR + Q\bar{S}$
 (B) $\bar{P}Q\bar{R}\bar{S} + \bar{Q}\bar{S}$ (D) $PQRS + \bar{Q}$
13. Two 4-bit 2's complement numbers 1011 and 0110 are added. The result expressed in 4-bit 2's complement notation is
- (A) 0001
 (B) 0010
 (C) 1101
 (D) cannot be expressed in 4-bit 2's complement

14. The input output characteristics of a Schmitt trigger is given in Fig. Q. 14. The noise margin of the Schmitt trigger is

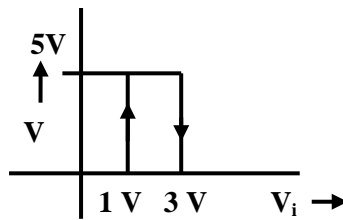


Fig. Q. 14

- (A) 1 V
(B) 2 V
(C) 3 V
(D) 4 V
15. Some of the pins of an 8085 CPU and their functions are listed below. Identify the correct answer that matches the pins to their respective functions
- | | |
|---------------------|--|
| P RST 7.5 | 1 Selects IO of memory |
| Q HOLD | 2 Demultiplexes the address and data bus |
| R IO \overline{M} | 3 Is a vectored interrupt |
| S ALE | 4 Facilitates direct memory access |
| | 5 Is a clock |
| | 6 Selects BCD mode of operation |
- (A) P – 3, Q – 2, R – 1, S – 4
(B) P – 4, Q – 1, R – 5, S – 3
(C) P – 3, Q – 4, R – 1, S – 2
(D) P – 2, Q – 3, R – 6, S – 1
16. A real function $f(t)$ has a Fourier transform $F(\omega)$. The Fourier transform of $[f(t) - f(-t)]$ is
- (A) zero
(B) real
(C) real and odd
(D) imaginary
17. A system of equations represented by $AX = 0$, where X is a column vector of unknowns and A is a matrix containing coefficients, has a nontrivial solutions when A is
- (A) nonsingular
(B) singular
(C) symmetric
(D) Hermetian
18. A sinusoidal signal of frequency 1 kHz is used to produce an FM signal with a modulation index $\beta = 5$. The bandwidth (where 98% of power is contained) of the FM signal is
- (A) 2 kHz
(B) 3 kHz
(C) 6 kHz
(D) 12 kHz

19. Given $x[n] = \frac{\sin \omega_c n}{\pi n}$, the energy of the signal given by $\sum_{n=-\infty}^{\infty} |x[n]|^2$ is
- (A) $\frac{\omega_c}{\pi}$
 - (B) $\pi \omega_c$
 - (C) Infinite
 - (D) $2\pi \omega_c$
20. The current coil of a 200V, 5A, electro-dynamometer type LPF wattmeter carries a current of $\sqrt{2} \cos(100\pi t)$ A. The voltage across the pressure coil is $\sqrt{2} 200 \sin(100\pi t)$ V. the meter will indicate
- (A) 0W
 - (B) 100W
 - (C) 200 W
 - (D) 400W
21. The clock frequency of a timer – counter is 10 MHz. the timer – counter is used in the period mode and the input to the timer – counter is a square wave of frequency 2 kHz. The display of the timer – counter will show a value
- (A) 200
 - (B) 2000
 - (C) 5000
 - (D) 50000
22. The insulation level for a 5 A full scale rectifier type ammeter is specified as 2.5 kV. It is then safe to use the meter with a potential difference of upto 2.5 kV between
- (A) the terminals of the meter
 - (B) case and the ground
 - (C) both the terminals and the case
 - (D) one of the terminals and the ground
23. An oscilloscope screen displays a line inclined at 45° . Its Y-input is a sine wave of frequency f then the X-input should be
- (A) sine wave of frequency f and 0° phase shift with the Y-input
 - (B) sine wave of frequency f and 45° phase shift with the Y-input
 - (C) sine wave of frequency f and 90° phase shift with the Y-input
 - (D) saw-tooth wave of frequency f
24. In a synchro pair, the control transmitter excites the three stator windings of the control transformer. The stator winding voltages will have
- (A) equal magnitudes but different phases
 - (B) different magnitudes and different phases
 - (C) equal magnitudes and phases
 - (D) different magnitudes but equal phases

25. The steady state error for the feedback control system shown in Fig. Q.25 when subjected to a unit step input is

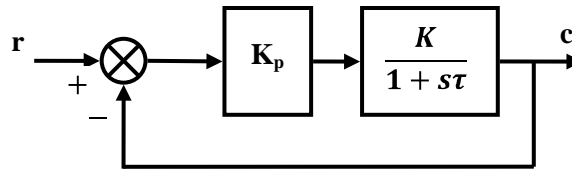


Fig. Q.25

- (A) zero
 (B) $\frac{1}{(1 + KK_p)}$
 (C) $\frac{KK_p}{(1 + KK_p)}$
 (D) infinite
26. A three-stack variable reluctance stepper motor has 12 numbers of rotor and stator teeth on each stack. The resolution of angular rotation for the stepper motor, assuming no. two stacks are excited simultaneously, is
- (A) 10°
 (B) 15°
 (C) 20°
 (D) 30°
27. In the feedback scheme shown in Fig. Q. 27, the time-constant of the closed loop system will be

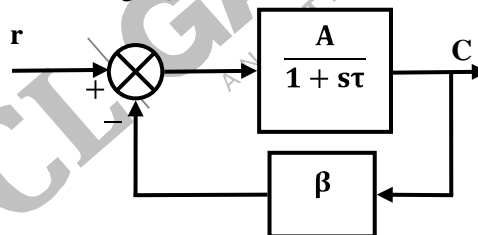


Fig. Q. 27

- (A) $A\beta\tau$
 (B) $(1 + A\beta, \tau)$
 (C) τ
 (D) $\frac{\tau}{(1 + A\beta)}$

28. A grating that has 1200 lines/mm is irradiated with a narrow beam of white light at an incident angle of 25° to the grating normal. The first order peak observed at an angle of 15° belongs to the wavelength
- (A) 567.9 nm (C) 597.1 nm
(B) 587.8 nm (D) 600.7 nm
29. A light beam is incident normally on a glass-air interface. The glass has a refractive index 1.53. Air is assumed to be of refractive index 1.0. The Fresnel, intensity reflection coefficient is
- (A) 0.53 (C) 0.044
(B) 0.25 (D) 0.022
30. A light source is formed by putting a pinhole to let in sunlight. The above light source has
- (A) NO spatial-or temporal coherence
(B) NO spatial coherence but has temporal cohenrece
(C) spatial coherence but NO temporal coherence
(D) quasi-monochromaticity

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31. An RTD is assumed to be represented in the range 0°C to 100°C by a linear model as
- $$R_T = R_0(1 + 0.004T)$$
- where T is the temperature in $^\circ\text{C}$. $R_0 = 100\ \Omega$ with a variation of $\pm 2\ \Omega$. The true model of the RTD is
- $$R_T = R_0(1 + 0.004T + 6 \times 10^{-7} T^2)$$
- Two worst-case error magnitude in the resistance value that will be introduced, if the linear model is used over a range of 0 to $100\ ^\circ\text{C}$, is
- (A) $2\ \Omega$ (C) $3.0\ \Omega$
(B) $2.8\ \Omega$ (D) $3.4\ \Omega$
32. Measurement of large external radius is possible with the help of an angle piece and a screw gage as shown in Fig. Q.32. The radius R can be expressed from the measurement of H and θ as

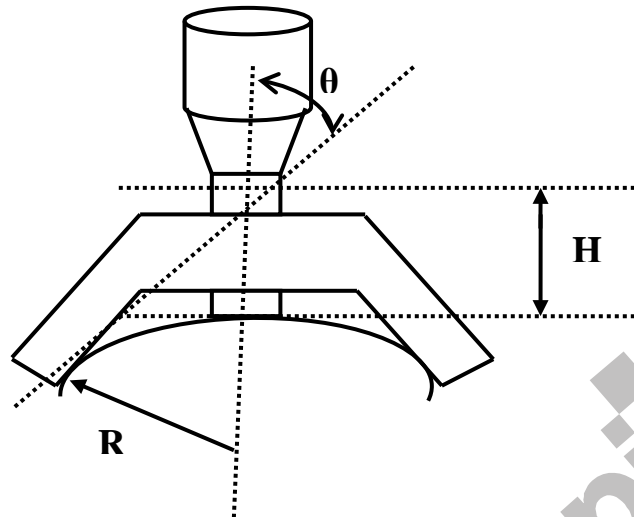


Fig. Q. 32

- (A) $\frac{H \sin \theta}{1 - \sin \theta}$
- (B) $\frac{H \cos \theta}{1 - \cos \theta}$
- (C) $\frac{H \tan \theta}{1 + \sin \theta}$
- (D) $\frac{H \sin \theta}{1 - \cos \theta}$

33. Koster's modification of Michelson interferometer is used to determine the thickness of a gage G . The gage G is placed on the mirror M_2 as shown in Fig. Q. 33(a). The field-of-view observed through the lens L is shown in Fig. Q. 33. (b). The fractional-fringe shift e , as shown in Fig. Q. 33 (b), is measured to be 0.15 when the wavelength of light used is $0.63 \mu\text{m}$. A quick check with a micrometer shows that the gage length is approximately $100 \mu\text{m}$. Then an accurate estimate of gage length, in μm , is

Quasi – monochromatic light

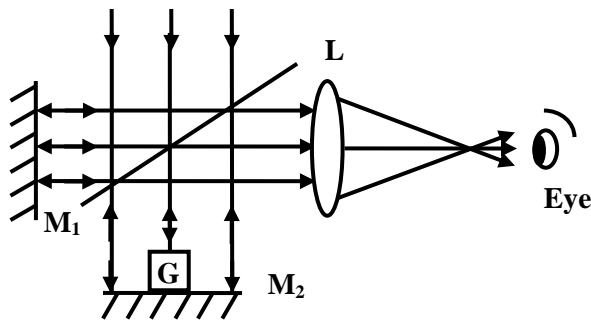


Fig. Q. 33(a)

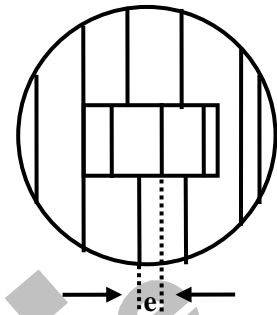


Fig. Q. 33(b)

- (A) 99.902
 (B) 100.804
 (C) 100.000
 (D) 101.706

34. A temperature-measuring instrument is modeled as a first order system with a time constant of 5s. The sensor of the instrument is placed inside an oil bath whose temperature has a sinusoidal variation with amplitude of 10°C and a period of 20s around an average temperature of 200°C . The sinusoidal component at the output of the instrument will have amplitude.
- (A) 0°C
 (B) 5.37°C
 (C) 8.57°C
 (D) 10°C

Data given below should be used for answering questions Q.35 and Q.36

The table provides the thermo-emf sensitivity of five materials with reference to platinum around 273K

Material	Constantan	Nickel	Copper	Iron	Nichrome
Sensitivity (μVK^{-1})	-35	-25	+6	+18.5	+25

35. The thermocouple pair that gives the maximum sensitivity around 273 K is
- (A) Platinum – Constantan
 (B) Nichrome – Constantan
 (C) Nickel – Constantan
 (D) Copper - Nickel
36. Two copper-constantan thermocouples are connected such that the two constantan wires are joined together. The two copper wires are connected to the input of a low noise chopper stabilized differential amplifier having a gain of 1000. One of the thermocouple junctions is immersed in a flask containing ice and water in equal proportion. The other thermocouple is at a temperature T. If the output of the amplifier is 2.050 V, the temperature T is
- (A) 205°C
 (B) 102.5°C
 (C) 51.25°C
 (D) 50°C

37. An N-type semiconductor strain gage has a nominal resistance of $1000\ \Omega$ and gage factor of -100 . The resistance of the gage, when a compressive strain of $100\ \mu\text{m}/\text{m}$ is applied, is

- (A) $900\ \Omega$ (C) $1010\ \Omega$
 (B) $990\ \Omega$ (D) $1100\ \Omega$

38. A signal conditioning circuit suitable for a push-pull type capacitive transducer is given in Fig. Q.38. The output V_0 is

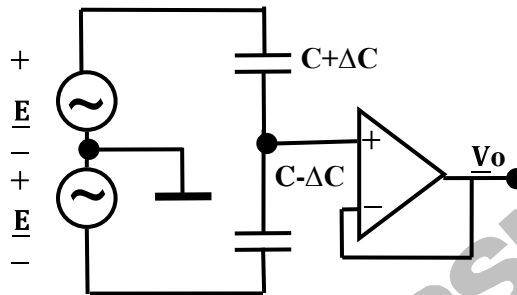


Fig. Q. 38

- (A) $V_0 = E \frac{C}{\Delta C}$ (C) $V_0 = E \frac{C - \Delta C}{C + \Delta C}$
 (B) $V_0 = E \frac{\Delta C}{C}$ (D) $V_0 = E \frac{C + \Delta C}{C - \Delta C}$

39. A Piezoelectric transducer with a sensitivity of $2.0\ \text{pC}/\text{N}$ having a capacitance of $1600\ \text{pF}$ and a leakage resistance of $10^{12}\ \Omega$ is connected to a charge amplifier as shown in Fig. Q.39. If a force of $0.1 \sin 10 t\ \text{N}$ is applied to the transducer, the output-amplitude of the charge amplifier is

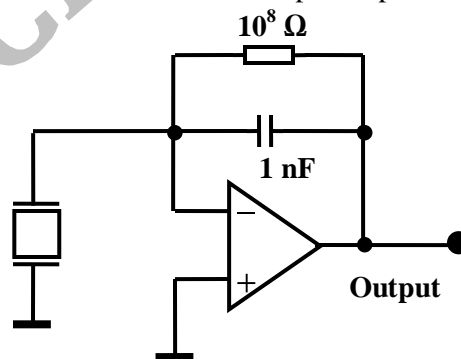


Fig. Q. 39

- (A) $0.141\ \text{mV}$ (C) $1.414\ \text{mV}$
 (B) $0.232\ \text{mV}$ (D) $1.732\ \text{mV}$

40. In a seismic acceleration sensor, with a displacement transducer as the secondary element, decreasing the mass while maintaining all other parameters of the sensor unchanged will
- reduce both natural frequency and steady-state sensitivity
 - increase both natural frequency and steady-state sensitivity
 - increase natural frequency but reduce steady-state sensitivity
 - increase natural frequency without affecting steady-state sensitivity
41. For a steady flow of liquid, the float of the rotameter will remain in a particular position when
- drag force is balanced by the weight of the float and buoyancy force
 - weight of the float is balanced by the drag force and buoyancy force
 - buoyancy force is balanced by the drag force and weight of the float
 - drag force and buoyancy together is slightly greater than the weight of the float
42. A photo-detector circuit is given in the Figure. The photo-diode has an active area of 10^{-2}cm^2 and sensitivity of 0.55 A/W . When light of intensity 10 m W/cm^2 falls on the photo-diode, the output V_0 is

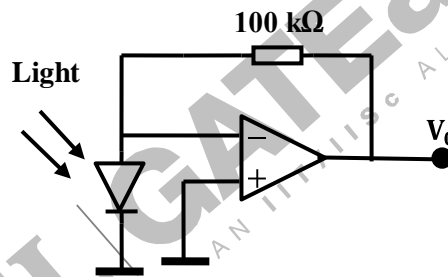


Fig. Q. 42

- 10.1 V
 - 5.5 V
 - 5.5 V
 - 10.1 V
43. A forward-biased silicon diode when carrying negligible current, has a voltage drop of 0.64 V. When the current is 1 A it dissipates 1 W. The ON-resistance of the diode is
- 0.36 Ω
 - 0.64 Ω
 - 0.72 Ω
 - 1.0 Ω
44. A transistor amplifier circuit is shown in the Figure. The quiescent collector current, rounded off to first decimal, is

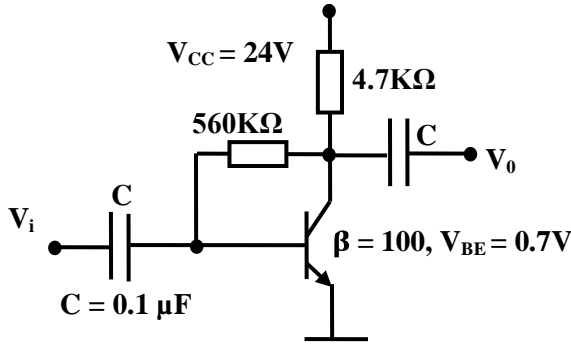


Fig. Q. 44

- (A) 2.6 mA
 (B) 2.3 mA
 (C) 2.1 mA
 (D) 2.0 mA
45. The opamp used in the inverting amplifier shown in Fig. Q.45 has an equivalent input offset voltage V_{ios} of 5mV. The output offset voltage is

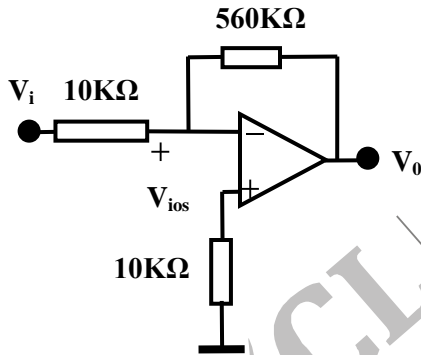


Fig. Q. 45

- (A) 5 mV
 (B) 280 mV
 (C) 285 mV
 (D) 560 mV
46. A resistance R_T of a resistive transducer is modeled as $R_T = R(1 - Kx)$, where K is the constant of transformation and x the input quantity being sensed. The resistor is connected to an ideal, opamp signal conditioning circuit of Fig. Q. 46. The value of R is 100Ω , K is 0.004 and x is 75 . The output V_0 is

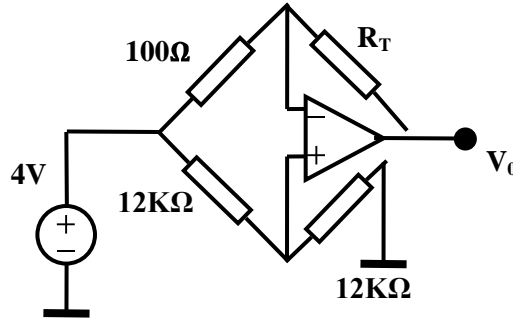


Fig. Q. 46

- (A) -400 mV (C) -300 mV
 (B) -4 mV (D) $+600\text{ mV}$

47. In the circuit in the Figure, the opamps used are ideal. The output V_0 is

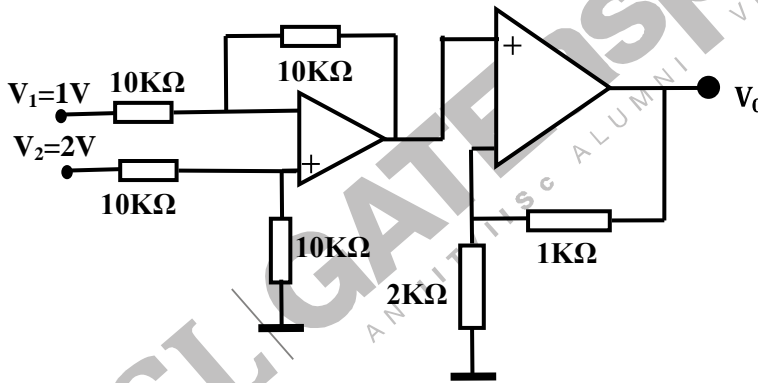


Fig. Q. 47

- (A) 3.0 V (C) 1.0 V
 (B) 1.5 V (D) 0.5 V

48. For an ECG amplifier, the input signals is $100\mu\text{V}$ corrupted by a common mode noise of 5mV . The output of the amplifier contains 50mV of signal and 0.001 mV of noise. The CMRR of the amplifier is

- (A) 40 dB (C) 80dB
 (B) 60dB (D) 100dB

49. A 50 W power amplifier has a rated output of 30V r.m.s and a voltage gain of 40 dB . It is connected to 40 W loudspeaker having an internal resistance of 10Ω . Determine the maximum

input voltage that can be given to the power amplifier so that neither the power amplifier nor the loudspeaker is overloaded.

- (A) 40 V
- (B) 20 V
- (C) 0.4 V
- (D) 0.2 V

50. The circuit shown in Fig. Q.50 is that of a waveform generator. Assuming ideal devices, and ± 12 V supply, the output V_0 is a

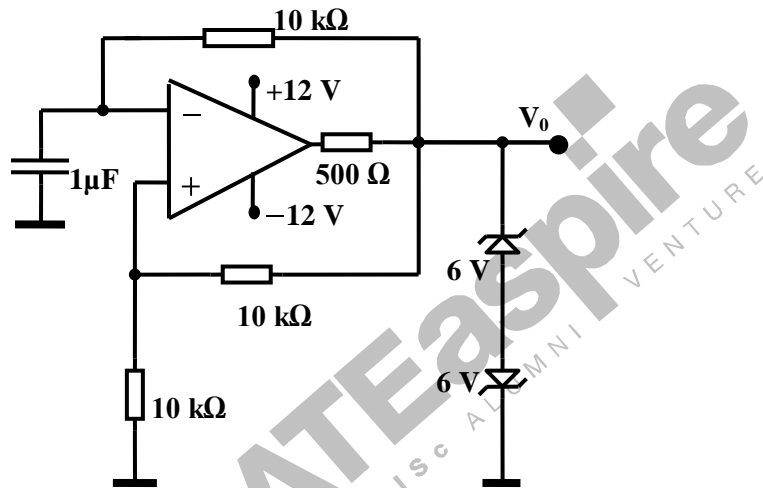


Fig. Q.50

- (A) triangular wave of period 120 ms and amplitude ± 6 V
- (B) square wave of period 60 ms and amplitude ± 6 V
- (C) square wave of period 120 ms and amplitude ± 6 V
- (D) square wave of period 60 ms and amplitude ± 12 V

51. The logic circuit of Fig. Q.51 is a

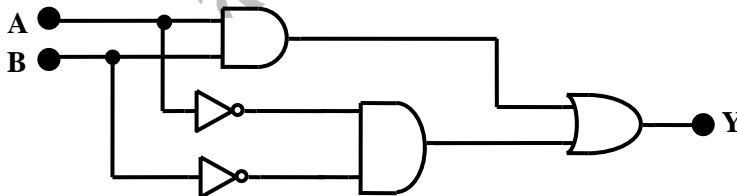


Fig. Q.51

- (A) half adder
- (B) XOR
- (C) equality detector
- (D) full adder

52. The correct cyclic sequence of the outputs (Q_0Q_1) for the JK master – slave flip-flop circuit shown in Fig. Q. 52 when the input clock is applied is

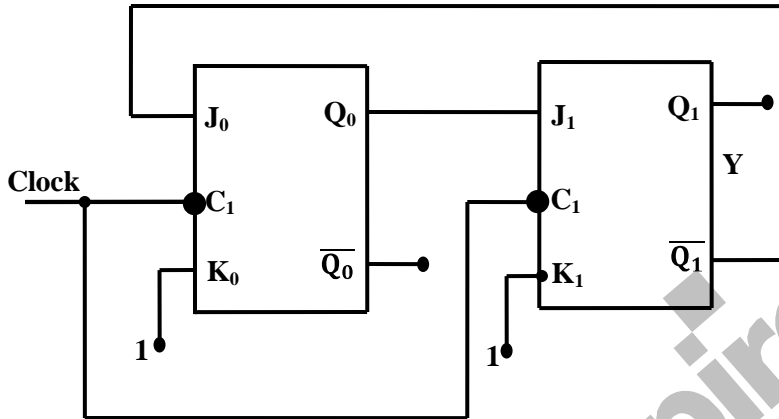


Fig.Q.52

- (A) 00, 01, 10, 11, 00, 01 (C) 00, 01, 10, 00, 01, 10,.....
 (B) 00, 10, 01, 00, 10, 01,..... (D) 00, 11, 00, 11, 00, 11,.....
53. For the CMOS analog switch shown in Fig.Q.53, the positive supply is $+V_{DD}$ and the negative supply is $-V_{EE}$. The input V_i is bipolar . The switch will be ON and V_o will be equal to V_i provided.

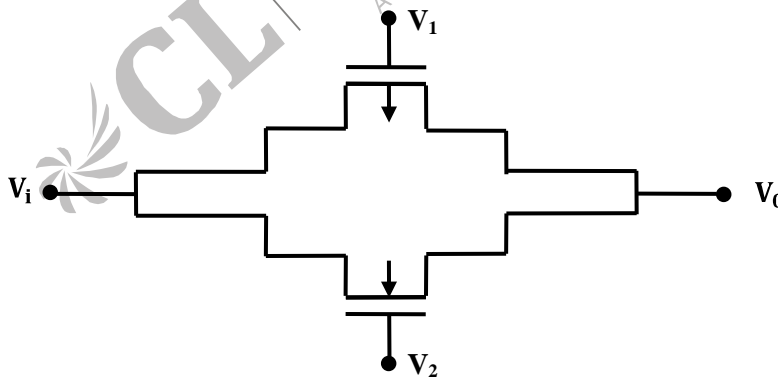


Fig. Q. 53

- (A) $V_1 = V_2 = +V_{DD}$ (C) $V_1 = +V_{DD}$ and $V_2 = -V_{EE}$
 (B) $V_1 = V_2 = -V_{EE}$ (D) $V_1 = -V_{EE}$ and $V_2 = +V_{DD}$

54. A 2-to-1 digital multiplexer having a switching delay of $1\mu\text{s}$ is connected as shown in Fig. Q.54. The output of the multiplexer is tied to its own select input S . The input which gets selected when $S = 0$ is tied to 1 and the input that gets selected when $S = 1$ is tied to 0. The output V_0 will be

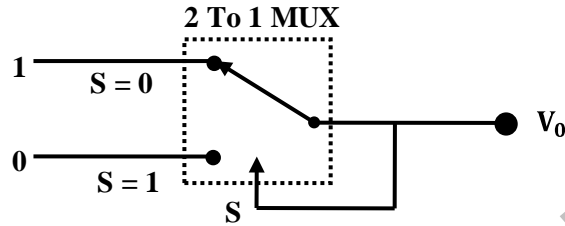


Fig. Q. 54

- (A) 0
(B) 1
(C) pulse train of frequency 0.5 MHz
(D) pulse train of frequency 1.0 MHz
55. The square wave C_1 shown in Fig. Q.55 is given to the clock input of a 4-bit binary up/down counter whose UP/ $\overline{\text{DN}}$ input is fed with the pulse train P_u . The counter is a negative edge triggered one. The counter starts with 0000 and will reach 0000 again at the

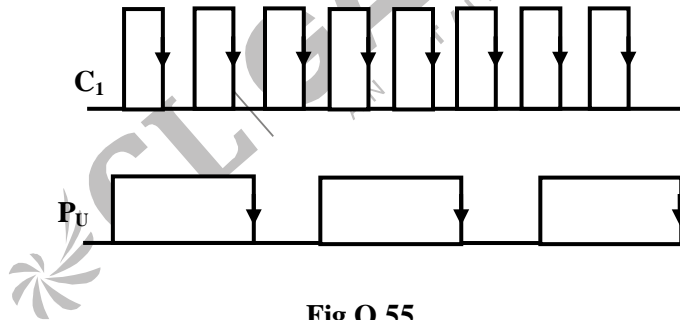


Fig.Q.55

- (A) 15th clock pulse
(B) 16th clock pulse
(C) 44th clock pulse
(D) 48th clock pulse

Data given below should be used for answering questions Q. 56 and Q. 57

In a dual slope ADC, the reference voltage is 100 mV and the first integration period is set as 50 ms . The input resistor of the integrator is $100\text{ k}\Omega$ and the integrating capacitor $0.047\text{ }\mu\text{F}$.

56. For an input voltage of 120 mV , the second integration (de-integration) period will be
- (A) 50ms
(B) 60ms
(C) 100ms
(D) 120ms

57. If the input of 120 mV is corrupted by power supply interference at 50 Hz having peak amplitude of 3π mV, the worst –case error introduced by the interference in the reading is

- (A) 0%
- (B) 1%
- (C) 3%
- (D) $\pi\%$

58. A ROM is interfaced to an 8085 CPU as indicated in Fig. Q.58. The address range occupied by the ROM is

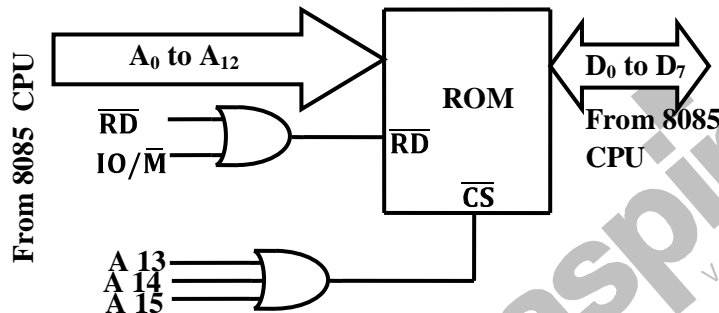


Fig.Q.58

- (A) 0000-0FFF
- (B) 0000-1FFF
- (C) 0000-2FFF
- (D) 8000-9FFF

59. In an 8085 system containing 8KB of ROM and 8KB of RAM , the ROM is selected when A 15 is 0 and the RAM is selected when A15 is 1. A13 and A14 are unused. The CPU executes the following program

```

Prog1      MVI A,00H
           STA 8080H
           DCR A
           STA C080H
           RET
    
```

The content of memory location 8080 H after the execution of the RETURN instruction is

- (A) FFH
- (B) FEH
- (C) 01H
- (D) 00H

60. A linear time invariant system with system function $H(z) = 1+z^{-1}+ z^{-2}$ is given an input signal sampled at 18 kHz. The frequency of the analog sinusoid which CANNOT pass through the system is

- (A) $\frac{12}{\pi}$ kHz
- (B) 6 kHz
- (C) 12 kHz
- (D) $\frac{6}{\pi}$ kHz

61. A discrete-time system with input $x[n]$ – output $y[n]$ relation $y[n] = x[n] - 2x[n-1] + x[n-2]$ is a good approximation to a
- (A) high-pass filter
 (B) band-stop filter blocking $\frac{\pi}{8} \leq |\omega| \leq \frac{\pi}{4}$
 (C) low-pass filter
 (D) band-pass filter passing $\frac{\pi}{8} \leq |\omega| < \frac{\pi}{4}$
62. The scheme shown in Fig. Q. 62 is used for the generation of wideband FM from a narrow band FM. The multiplier box multiplies the input frequency by the factor shown. The input $x(t)$ is a narrow band FM signal of carrier 100 kHz and frequency deviation of 25 Hz. The local oscillator frequency in kHz and the multiplication constant m to achieve an output $y(t)$ with a carrier of 2.0 MHz and a frequency deviation of 1.0 kHz are respectively:

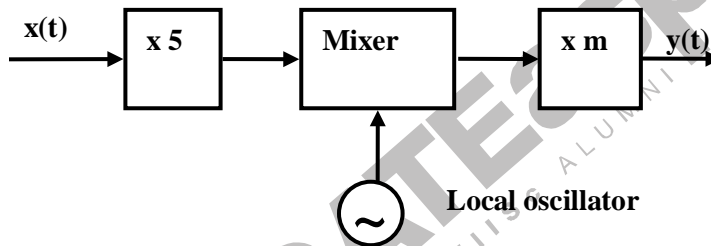


Fig. Q. 62

- (A) 750,4
 (B) 1000,4
 (C) 750,8
 (D) 1000,8
63. Given $h[n] = [1, 2, 2]$, $f[n]$ is obtained by convolving $h[n]$ with itself and $g[n]$ by correlating $h[n]$ with itself. Which one of the following statements is true?
- (A) $f[n]$ is causal and its maximum value is 9
 (B) $f[n]$ is non-causal and its maximum value is 8
 (C) $g[n]$ is causal and its maximum value is 9
 (D) $g[n]$ is non-causal and its maximum value is 9
64. Bilinear transformation avoids the problem of aliasing encountered with the use of impulse-invariance through
- (A) mapping the entire imaginary axis of the s -plane onto the unit circle in the z -plane
 (B) pre-filtering the input signal to impose band-limitedness

- (C) mapping zeros of the left half of the s-plane inside the unit circle in the z-plane
- (D) up-sampling the input signal so that the bandwidth is reduced

65. A linear phase FIR system with impulse response real has a zero at $z = \frac{1}{2}e^{j\frac{\pi}{4}}$. The largest set of remaining zeros that can be obtained from the above information is

- (A) $\frac{1}{2}e^{j\frac{\pi}{2}}, \frac{1}{2}e^{j\frac{3\pi}{4}}, \frac{1}{2}e^{j\frac{\pi}{2}}$
- (B) $\frac{1}{2}e^{-j\frac{\pi}{2}}, \frac{1}{2}e^{-j\frac{3\pi}{4}}, \frac{1}{2}e^{-j\frac{\pi}{2}}$
- (C) $2e^{-j\frac{\pi}{4}}, 2e^{j\frac{\pi}{4}}, \frac{1}{2}e^{-j\frac{\pi}{4}}$
- (D) $2e^{j\frac{\pi}{4}}, \frac{1}{2}e^{-j\frac{\pi}{4}}$

66. Given $x = [a, b, c, d]$ as the input, linear time invariant system produces an output $y = [x, x, x, x \dots, < \text{repeated } N \text{ times} >]$. The impulse response of the system is

- (A) $\sum_{i=0}^{N-1} \delta[n - 4i]$
- (B) $u[n] - u[n - N]$
- (C) $u[n] - u[n - N - 1]$
- (D) $\sum_{i=0}^{N-1} \delta[n - i]$

67. The sequence $x[n]$ whose z-transform is $X(z) = e^{112z}$ is

- (A) $\frac{1}{n!} u[n]$
- (B) $\frac{1}{-n!} u[-n]$
- (C) $(-1)^{\frac{1}{n!}} u[n]$
- (D) $\frac{1}{-(n+1)!} u[-n - 1]$

68. Direct form implementation of the FIR structure shown in Fig. Q.68 (a) is also implemented in Fig. Q.68 (b) in lattice form. The coefficients k_1 and k_2 are respectively

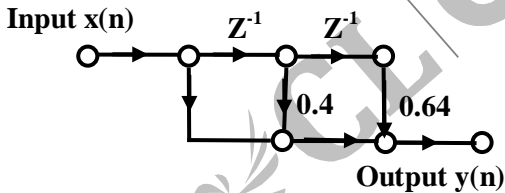


Fig. Q. 68(a)

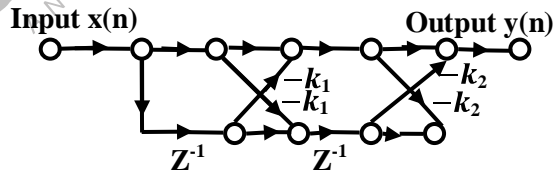


Fig. Q. 68(b)

- (A) 0.640 and -0.244
- (B) 0.640 and 0.244
- (C) 0.244 and 0.640
- (D) -0.244 and -0.640

69. The output resistance across the terminals 1 and 2 of the DC bridge in Fig. Q.69 is

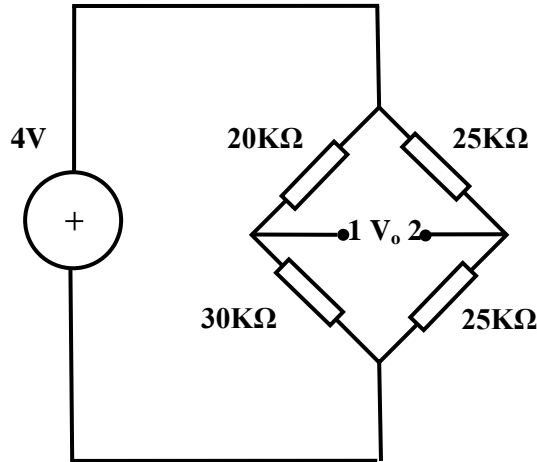


Fig. Q. 69

- (A) 12.5 kΩ
- (B) 24.5 kΩ
- (C) 25.0 kΩ
- (D) 100 kΩ

70. For the bridge circuit in Fig. Q.70, the voltages are

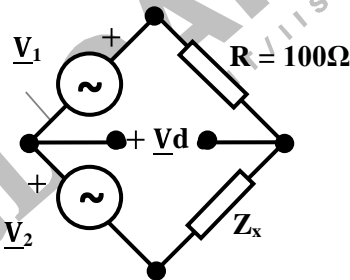


Fig. Q. 70

$$\underline{V}_1 = \sqrt{2} \cos 1000 t \text{ V,}$$

$$\underline{V}_2 = 2\cos (1000 t + 45^\circ) \text{ and}$$

$$V_d = 0.$$

The value of $R = 100 \Omega$ Then Z_x will be

- (A) 100 Ω resistor in series with 100 mH inductor
- (B) 100 Ω resistor in series with 100 μF capacitor
- (C) 100 Ω resistance in parallel with 100 mH inductor
- (D) 100 Ω resistance in parallel with 100 μF capacitor

71. An oscilloscope is powered from 230 V mains having a nominal frequency of nearly 50 Hz. The triggering mode of the oscilloscope is set to LINE. A square wave from a function generator is fed to the Y input and a stable display (properly triggered) is obtained when the frequency of the function generator is 297 Hz. The actual frequency of the power supply is
 (A) 50 Hz (C) 49.0 Hz
 (B) 49.5 Hz (D) 48.5 Hz
72. The primary of a 200/1 A, 5 VA, 0.8 PF current transformer (CT) carries 100 A. The secondary current is 0.495 A. The ratio error of the CT is
 (A) -1.0% (C) $+0.5\%$
 (B) -0.5% (D) $+1.0\%$
73. A very low-loss coil tested with a Q-meter and the distributed (self) capacitance of the coil is found to be 820 pF. Resonance occurred at an angular frequency ω of 10^6 rad./s with a capacitance of 9.18 nF. The inductance of the coil is
 (A) 100pH (C) 100 nH
 (B) 100 μ H (D) 100mH
74. A potentiometer circuit is shown in Fig. Q. 74. The jockey of the potentiometer is kept exactly at the mid-point and the ammeter reads the current, I, as 0.2 mA. When V_x is reversed the ammeter reads 3.8 mA. The internal resistance of the ammeter and the unknown potential V_x are respectively

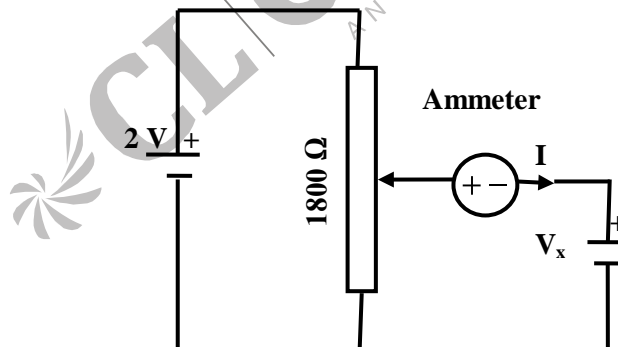


Fig.Q.74

- (A) 500 Ω , 1.1 V (C) 500 Ω , 0.9 V
 (B) 50 Ω , 1.1 V (D) 50 Ω , 0.9 V

75. The 5 V Zener diode in Fig. Q. 75 is ideal and the ammeter (A), of full-scale 1 mA, has an internal resistance of 100 Ω. The circuit shown, with terminal 1 positive,

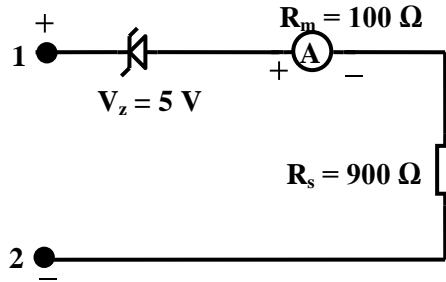


Fig. Q. 75

(A) 0 – 1 VDC voltmeter
 (B) 0 – 1 mA DC ammeter
 (C) 0 – 6 V DC voltmeter
 (D) 0 – 5 V AC voltmeter

76. The transfer function of a system is $\frac{A}{s^2 + \omega^2}$. The steady-state gain of the system to a unit-step input is

(A) $\frac{A}{\omega^2}$
 (B) 0
 (C) ∞
 (D) not possible to be determined

77. The closed loop control system shown in Fig. Q.77 has $\tau_1 > 0$. The system will remain stable for all τ_1 in the range

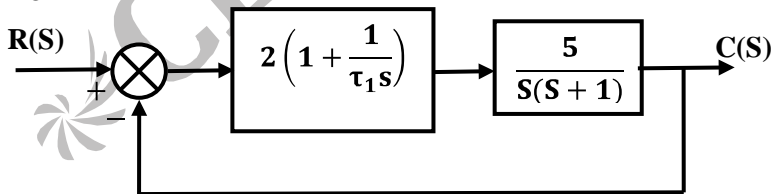


Fig. Q. 77

(A) $\tau_1 < 0.5$
 (B) $0.5 < \tau_1 < 1.0$
 (C) $\tau_1 < 1.0$
 (D) $\tau_1 > 1.0$

78. In Fig. Q.78, K_1 and K_2 are proportional controllers. For the control system to remain stable, the upper limits of K_1 and K_2 are

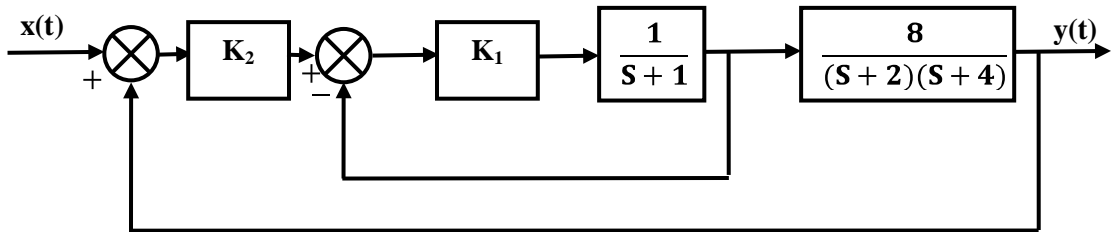


Fig. Q. 77

- (A) ∞, ∞ (C) $\infty, 10$
 (B) $1, \infty$ (D) $10, 1$
79. The response of a system to a unit impulse is $y(t) = e^{-5(t-1)}$. Which one of the following is the correct statement about the system?
 (A) The system is nonlinear
 (B) The system is unstable in open loop
 (C) The steady-state gain of the system for a unit input is 0.2
 (D) The steady-state gain of the system for a unit step input is 1.0
80. A PID controller has the transfer function $2 + \frac{0.4}{s}$ with the unit of time expressed in minutes. The parameters proportional band and reset time for the above controller are respectively
 (A) 200% and 0.4 min. (C) 200% and 5 min.
 (B) 50% and 0.4 min. (D) 50% and min.
81. For a dynamic system, various matrices for a state space model are given by $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ and $C = [10]$. The system poles are located at
 (A) $-2, -1$ (C) $-3, -1$
 (B) $-2, -3$ (D) $-1, 0$
82. The transfer function of a system is given by $\frac{Y(s)}{X(s)} = \frac{e^{-0.1s}}{1+s}$. If $x(t)$ is $0.5 \sin t$, then the phase angle between the output and the input will be
 (A) -39.27° (C) -50.73°
 (B) -45° (D) -90°

83. The transfer function of a second order band-pass filter, having a centre frequency of 1000 rad/s selectivity of 100 and a gain of 0 dB at the centre frequency, is

(A) $\frac{10s}{s^2 + 10s + 10^6}$

(C) $\frac{100s}{s^2 + 100s + 10^7}$

(B) $\frac{s}{s^2 + s + 10^6}$

(D) $\frac{100s}{s^2 + 100s + 10^6}$

Data given below should be used for answering questions Q. 84 and Q. 85

The root locus plot for a system, with transfer function $\frac{2}{s(s+1)(s+2)}$, is shown in Fig Q.84. A

unity feedback proportional control system is built using this system.

84. The maximum possible controller gain, for which the unity feedback system is stable, is approximately

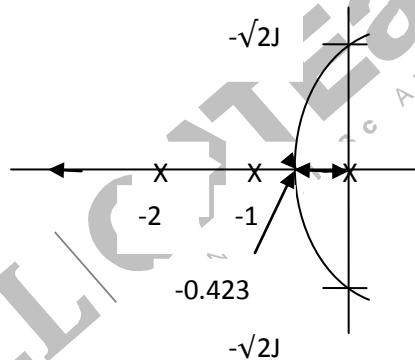


FIG Q.84

(A) 6.0

(C) 0.4

(B) 3.0

(D) 0.2

85. The maximum possible controller gain, for which the unity feedback system exhibits a non-oscillatory response to a unit step input, is

(A) 6.0

(C) 0.4

(B) 3.0

(D) 0.2

86. An ultrasonic beam of frequency 1 MHz and intensity 0.5 W/cm^2 passes through a layer of soft tissue of thickness t with an attenuation coefficient of 1.18 cm^{-1} . The ratio of output to input power is $1/e^2$. The thickness of the tissue is
- (A) 1 cm (C) 2.408 cm
(B) 1.695 cm (D) 3.721 cm
87. The refractive indices of the core and cladding of an optical fibre are 1.46 and 1.455 respectively. The diameter of the core is $4 \mu\text{m}$. When operated at a wavelength of $1.31 \mu\text{m}$, the fiber functions as a
- (A) single-mode fibre with a numerical aperture of 0.1
(B) multimode fibre with a numerical aperture of 0.15
(C) single-mode fibre with a numerical aperture of 0.12
(D) ten-mode fibre with a numerical aperture of 0.12
88. A cardiac output measurement set-up uses the thermo-dilution principle. The change in the output temperature is 7°C for 5.60 litres per minute of cardiac output with an integration time of 10 s. For a second measurement, with all other parameters remaining unchanged, the change in the temperature is 10°C with an integration time of 20 s. The cardiac output in litres per minute for this will be
- (A) 5.60 (C) 3.92
(B) 4.21 (D) 1.96
89. X-rays emitted from a molybdenum target at 35 kV have wavelength edges $K_\alpha = 70.9 \text{ pm}$ and $K_\beta = 63.2 \text{ pm}$. These X-rays are passed through a zirconia filter of K-edge 68.9 pm . The output of the filter contains primarily X-rays of wavelengths
- (A) 63.2 pm (C) Both 63.2 pm and 70.9 pm
(B) 70.9 pm (D) Neither 63.2 pm nor 70.9 pm
90. A quasi-monochromatic light source with average central wavelength of 630 nm has a spectral width of 10GHz. The coherence length of the source is
- (A) $3\mu\text{m}$ (C) 3cm
(B) 3mm (D) 3m.