

**Q. 1 – 30 Carry One Mark Each**

1. A zero error in a vernier caliper is termed as  
(A) accidental error (C) interference error  
(B) systematic error (D) random error
2. Filtering is performed in surface finish measurement as a means of separating roughness and waviness. In roughness measurement, the wavelengths that are filtered out are  
(A) half the cut-off wavelength (C) equal to the cut-off wavelength  
(B) shorter than the cut-off wavelength (D) longer than the cut-off wavelength
3. The following terms used in the context of an instrument are numbered as shown:  
(1) accuracy, (2) sensitivity, (3) precision and (4) resolution  
Match these with their possible definitions listed below  
P. Repeatability of readings on successive observations  
Q. Smallest perceptible change in the output  
R. Deviation of the output from the true value  
S. Minimum value of the input from the true value  
T. Ratio of the change in the instrument reading to the change in the measured variable.  
(A) 1 – P, 2 – Q, 3 – R, 4 – S (C) 1 – R, 2 – T, 3 – P, 4 – Q  
(B) 1 – S, 2 – Q, 3 – P, 4 – T (D) 1 – T, 2 – Q, 3 – P, 4 – R
4. For a proving ring used in a press, the value of force and its uncertainty are given as  $12355 \pm 2354 \text{ N}$  without any rounding off. If the error should be rounded off at the maximum to two significant figures only, the value of the reading is rounded off as  
(A)  $12300 \pm 2300 \text{ N}$  (C)  $12400 \pm 2300 \text{ N}$   
(B)  $12360 \pm 2350 \text{ N}$  (D)  $12400 \pm 2400 \text{ N}$
5. A viscous damper consists of a sliding piston and a cylinder filled with oil of kinematic viscosity  $5 \times 10^{-5} \text{ m}^2/\text{s}$ . A damping force of 20N is applied on the piston and the steady state velocity reached is 10mm/s. The damping co-efficient of the damper is  
(A) 2 Ns/mm (C) 10Ns/mm  
(B) 4 Ns/mm (D) 20Ns/mm

6. For a first order instrument a 5% settling time is equal to  
 (A) three times the time constant  
 (B) two times the time constant  
 (C) the time constant  
 (D) time required for the output signal to reach 5% of the final value
7. To avoid the effect of fringing, the potential of the guard ring of a capacitance transducer, shown in fig. Q.7 is to be made equal to

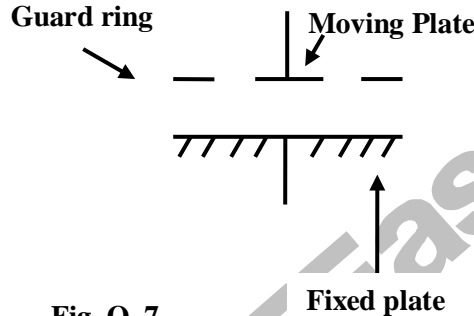


Fig. Q. 7

- (A) the ground potential  
 (B) half of the excitation voltage  
 (C) the voltage of the fixed plate  
 (D) the voltage of the moving plate
8. The excitation frequency of an LVDT is 2 kHz. The maximum frequency of displacement should be limited to  
 (A) 200 Hz  
 (B) 1.5 kHz  
 (C) 2 kHz  
 (D) 2.5 kHz
9. Assuming ideal diode characteristics, the input/output voltage relationship for the circuit shown in fig. Q.9 is

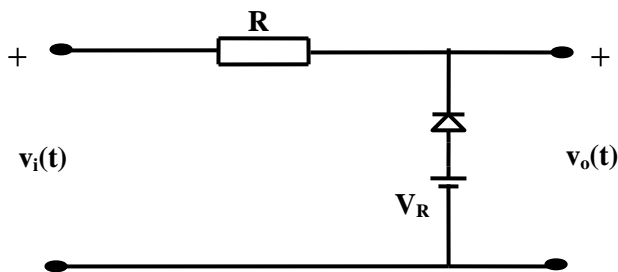


Fig. Q.9

- (A)  $v_0(t) = v_i(t)$ , for all  $v_i(t)$
- (B)  $v_0(t) = v_i(t)$ , for  $v_i(t) > v_R$   
= 0, otherwise
- (C)  $v_0(t) = v_i(t)$ , for  $v_i(t) < v_R$   
=  $v_R$ , otherwise
- (D)  $v_0(t) = v_i(t)$ , for  $v_i(t) > v_R$   
=  $v_R$ , otherwise

10. The output of the opamp in the circuit of fig. Q. 10 is

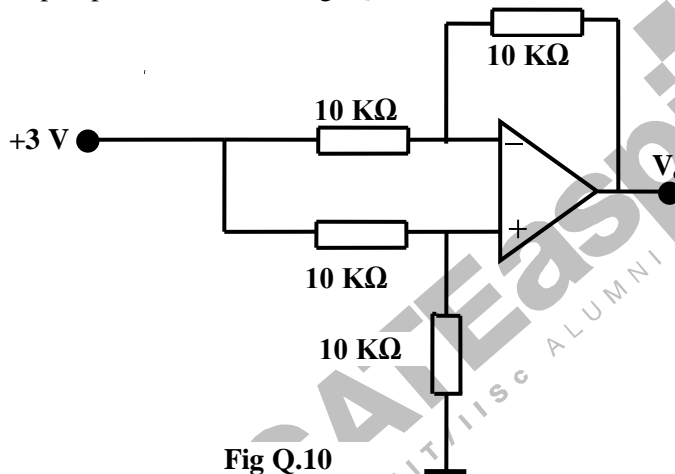


Fig Q.10

- (A) 0 V
- (B) -3 V
- (C) +1.5V
- (D) +3 V

11. The device shown in Fig. Q. 11 is a

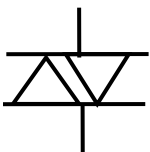


Fig. Q. 11

- (A) Variac
- (B) Triac
- (C) Quadrac
- (D) Diac

12. The vectored address corresponding to the software interrupt command RST7 in 8085 microprocessor is

- (A) 0017H
- (B) 0027H
- (C) 0038H
- (D) 0700H

13. The number of comparators required in an 8-bit flash-type A/D converter is  
 (A) 256 (C) (8+2)  
 (B) 255 (D) 8
14. The simplest form of the Boolean expression  $AB\bar{C}\bar{D} + ABC\bar{D} + AB\bar{C}D + ABCD$  is  
 (A)  $AD$  (C)  $\bar{A}B$   
 (B)  $BC$  (D)  $AB$
15. The two NAND gates before the latch circuit shown in the figure are used to

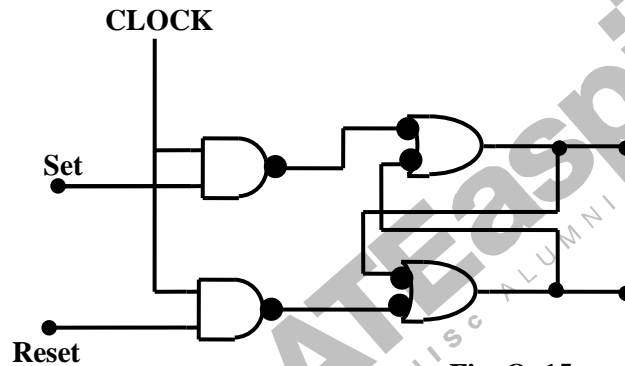


Fig. Q. 15

- (A) act as buffers (C) avoid racing problem  
 (B) operate the latch faster (D) invert the latching action
16. If the Fourier transform of  $x[n]$  is  $X(e^{j\omega})$ , then the Fourier transform of  $(-1)^n x[n]$  is  
 (A)  $(-j)^\omega X(e^{j\omega})$  (C)  $X(e^{j(\omega-\pi)})$   
 (B)  $(-1)^\omega X(e^{j\omega})$  (D)  $\frac{d}{d\omega} (X(e^{j\omega}))$
17. The Nyquist rate of sampling of an analog signal  $s(t)$  for alias free reconstruction is 5000 samples/s. For a signal  $x(t) = [s(t)]^2$  the corresponding Nyquist sampling rate in samples/s is  
 (A) 2500 (C) 10000  
 (B) 5000 (D) 25000

18. A signal  $x(t) = 5 \cos(150\pi t - 60)$  is sampled at 200Hz. The fundamental period of the sampled sequence  $x[n]$  is
- (A)  $\frac{1}{200}$   
(B)  $\frac{2}{200}$   
(C) 4  
(D) 8
19. The brake magnet of an error free electromechanical, induction type energy meter is shifted from its position and moved a small distance towards the edge of the disc. Then the meter will
- (A) continue to work correctly without any change in its characteristics  
(B) continue to work, but registers a lower kWhr  
(C) continue to work, but registers a higher kWhr  
(D) stop working
20. A quartz peizo-electric type pressure sensor has a built-in charge amplifier. The sensor has a sensitivity of  $1 \mu\text{V}/\text{Pa}$ . It is subjected to a constant pressure of 120 kPa. The output of the transducer at steady state is
- (A) 0 mV  
(B) 100  $\mu\text{V}$   
(C) 120  $\mu\text{V}$   
(D) 120 mV
21. A dc voltage of magnitude 11 kV is to be measured without loading the source under steady condition. The best-suited instrument is
- (A) a rectifier type voltmeter  
(B) an electrodynamic type voltmeter  
(C) a megger  
(D) an electrostatic voltmeter
22. In a single beam, single trace analog oscilloscope, a delay line is inserted between
- (A) X-input and X-plates  
(B) Y-input and Y-plates  
(C) X-input and the trigger circuit  
(D) Y-input and the trigger circuit
23. The dominant poles of a servosystem are located at  $s = (-2 \pm j2)$ . The damping ratio of the system is
- (A) 1  
(B) 0.8  
(C) 0.707  
(D) 0.6

24. The steady state error due to a unit-step disturbance input  $D(s)$  in figure is

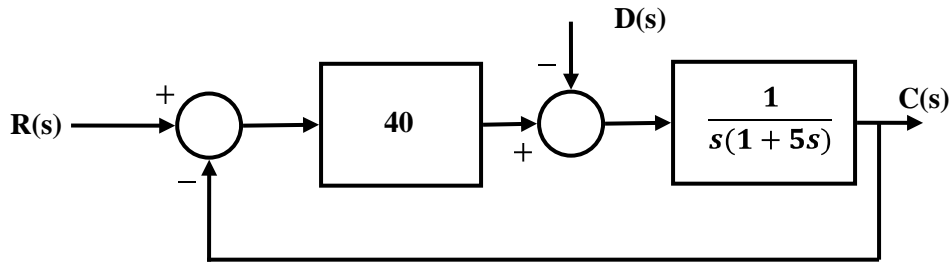


Fig. Q. 24

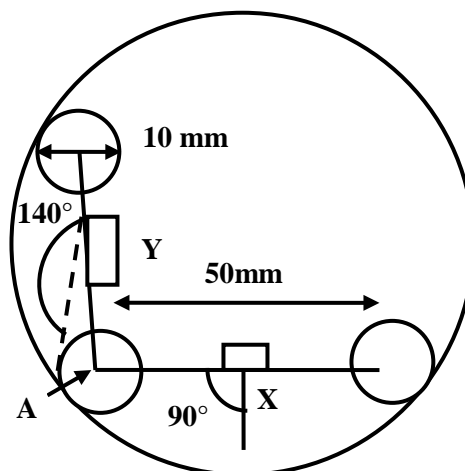
- (A) 0  
(B) 0.012  
(C) 0.021  
(D) 0.025
25. A thermocouple can be considered as a single capacity system with a time constant of 100 ms and unity gain. It is immersed in a heat bath whose temperature is varying at  $1^\circ\text{C/s}$  from  $0^\circ\text{C}$ . When the actual temperature of the heat bath is  $70^\circ\text{C}$ , the reading of the thermocouple will be  
(A)  $70.1^\circ\text{C}$   
(B)  $71^\circ\text{C}$   
(C)  $69.9^\circ\text{C}$   
(D)  $69^\circ\text{C}$
26. The proportional band of a PI controller is 50% and the reset time is 0.2s. The transfer function of the controller is given by  
(A)  $50 \left( 1 + \frac{1}{0.2s} \right)$   
(B)  $50 \left( 1 + \frac{1}{5s} \right)$   
(C)  $2 \left( 1 + \frac{1}{5s} \right)$   
(D)  $2 \left( 1 + \frac{1}{s} \right)$
27. Match the bipolar limb leads to the correct combination of electrodes used in ECG
- | Group-1    | Group-2                  |
|------------|--------------------------|
| P.Lead I   | 1.Left leg and Right arm |
| Q.Lead II  | 2.Left leg and Right leg |
| R.Lead III | 3.Left arm and Right arm |
|            | 4.Left leg and Left arm  |
- (A) P – 1, Q – 3, R – 4  
(B) P – 3, Q – 1, R – 4  
(C) P – 4, Q – 1, R – 3  
(D) P – 2, Q – 1, R – 4

28. The refractive index of the core of an optical fiber is  $n_1$  and that of the cladding is  $n_2$ . If  $(n_1 - n_2) = \Delta n$ , then the fiber can be made single mode with numerical aperture unchanged by
- reducing core diameter and increasing  $\Delta n$
  - reducing both core diameter and  $\Delta n$
  - reducing core diameter alone
  - reducing  $\Delta n$  alone
29. For nuclear radiation measurement, a proportional counter has, in comparison to a Geiger counter,
- lower dead time and higher count rate
  - higher dead time and higher count rate
  - higher internal amplification
  - higher internal amplification and lower count rate
30. Water vapour absorbs electromagnetic radiation primarily in the range of
- X-ray
  - IR
  - UV
  - $\gamma$ -ray

**Q. 31 -90 Carry Two Marks Each**

31. A device for measuring large internal diameters consists of two arms X and Y of length 50 mm each and pivoted at A (given figure). These are fitted with 3 equal size rollers of diameter 10mm. The arms are fitted with tilt sensors, which indicate the angle of inclination of the arms with reference to the axis of gravity measured in clockwise direction. If these angles of inclination of the arms X and Y are  $90^\circ$  and  $140^\circ$  respectively, then the internal diameter of the measured device is

Fig. Q. 31



- (A) 110.6mm (C) 120.3 mm  
(B) 118.6 mm (D) 128.3mm
32. An outside micrometer having an anvil and spindle diameter of 6mm is used for measuring the diameter of a cylindrical part having a nominal diameter of 12 mm. During measurement, misalignment of the centerline of the work-piece and measuring instrument has occurred. If the tilt of the shaft axis is  $3^\circ$  then the error in the measurement is  
(A) 1.74% (C) 2.32%  
(B) 2.76% (D) 1.86%
33. A cylindrical piece ground on a center-less grinding machine is uniformly three lobed. The contour of the lobed surface has the smaller radius  $r_1 = 10$  mm and the larger radius  $r_2 = 10.3$  mm. The size of a truly circular ring gauge, which just fits over this cylindrical piece, is  
(A) 20.3 mm (C) 20.465mm  
(B) 20.346mm (D) 20.521mm
34. The calibration data for a pressure compensator of a pump is given below
- |          |     |     |     |     |     |     |     |     |     |     |     |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Input x  | 0   | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |
| Output y | 9.5 | 8.4 | 7.8 | 7.4 | 6.1 | 5.4 | 5.2 | 4.6 | 3.2 | 1.9 | 1.1 |
- For the given data, the slope of the best-fit line applying least square method is  
(A) 0.921 (C) 0.819  
(B) -0.803 (D) -0.945
35. A cantilever-type micro-accelerometer is designed by scaling down each dimension of a macro-accelerometer by a factor of 100. If the natural frequency of the macro-accelerometer is  $\omega$ , then the natural frequency of the micro-accelerometer will be  
(A)  $100 \omega$  (C)  $0.1 \omega$   
(B)  $10 \omega$  (D)  $0.01 \omega$
36. A pressure sensor has the following specifications  
Sensitivity at the design temperature = 10 V/MPa, Zero drift = 0.01 V/°C,  
Sensitivity drift = 0.01 (V/MPa)/°C  
When the sensor is used in an ambient 20 °C above the design temperature, the output from the device is 7.4V. The true value of the pressure will be  
(A) 0.71 MPa (C) 0.65 MPa  
(B) 0.68 MPa (D) 0.61 MPa

37. A variable capacitance angular velocity pickup is made with two concentrically mounted parallel semicircular plates with a small separation between them as shown in the figure. A dc voltage is connected across the terminals of the capacitance sensor as shown. For a constant angular velocity  $\omega$ , the waveform of the current  $i(t)$  will be

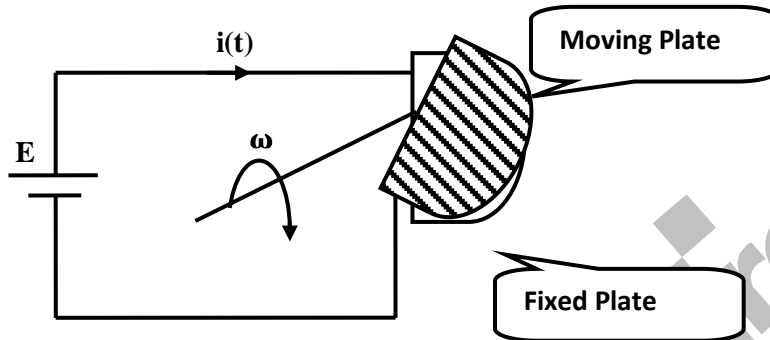
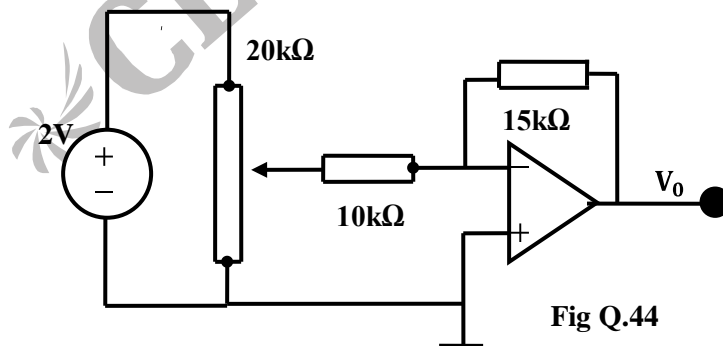


Fig. Q. 37

- (A) dc  
(B) sinusoidal  
(C) triangular  
(D) square
38. A strain gauge of resistance  $120\Omega$  and gauge factor 2.0 is at zero strain condition. A  $200k\Omega$  fixed resistance is connected in parallel with it. Then the combination will represent an equivalent strain of  
(A)  $+5290 \mu\text{m/m}$   
(B) zero  
(C)  $-123.8 \mu\text{m/m}$   
(D)  $-300 \mu\text{m/m}$
39. An iron constantan thermocouple is to be used to measure temperature between  $0$  and  $300^\circ\text{C}$ . With reference junction at  $0^\circ\text{C}$ , the *emf* induced at  $100^\circ\text{C}$  and  $300^\circ\text{C}$  are  
 $E_{100} = 5268\mu\text{V}$ ,  $E_{300} = 16325\mu\text{V}$   
Then the nonlinearity at  $100^\circ\text{C}$  as a percentage of full scale is  
(A)  $+3.23\%$   
(B)  $-1.06\%$   
(C)  $-0.96\%$   
(D)  $+3.23\%$
40. A quartz clock employs a ceramic crystal with a nominal resonance frequency of  $32.768 \text{ kHz}$ . The clock loses  $30.32 \text{ s}$  every 23 days. The actual resonance frequency of the crystal is  
(A)  $32.7685 \text{ kHz}$   
(B)  $32.768 \text{ kHz}$   
(C)  $32.7675 \text{ kHz}$   
(D)  $32.7670 \text{ kHz}$

41. A single-sensor, contact-type ultrasonic flow detector uses a frequency of 330 kHz. When testing a specimen, an echo from a flaw is recorded 0.05 ms after the transmitted pulse. If the velocity of sound in the test object is 6.0 km/s then the flaw is at a depth of  
 (A) 120cm (C) 30cm  
 (B) 60cm (D) 15cm
42. A PIN photodetector has a junction capacitance of 16 pF, active area of 10 mm<sup>2</sup> and a responsivity of 0.5 A/W. It is illuminated by a light of intensity 1 mW/cm<sup>2</sup>. A voltage output is obtained by connecting a 100 kΩ load resistor  $R_L$  in series with the detector. The steady state voltage across  $R_L$  will be  
 (A) 0.5 V (C) 5.0 V  
 (B) 1.5V (D) 7.0 V
43. An electromagnetic flowmeter is used to measure the average flow rate of a liquid in a pipe of diameter 50 mm. The flux density in the liquid has a peak value of 0.1 T. The output from the flowmeter is taken to an amplifier of gain 1000 and input impedance of 1 MΩ. If the impedance of the liquid between the electrodes is 200 kΩ, then the peak value of the amplifier output voltage for an average flow velocity of 20mm/s is  
 (A) 1.365 V (C) 0.1V  
 (B) 1 V (D) 0.083V
44. The wiper of the 20 kΩ potentiometer in Figure is positioned half way. Then the voltage  $V_0$  of the circuit is



- (A) -1.5V (C) -0.75V  
 (B) -1.0V (D) +2.5V
45. The parameters of the JFET in figure are:  $g_m = 1 \text{ mA/V}$ ,  $r_d = 15 \text{ k}\Omega$ . Neglecting the effect of the capacitor for A.C. analysis, the small signal A.C. voltage gain for the circuit is

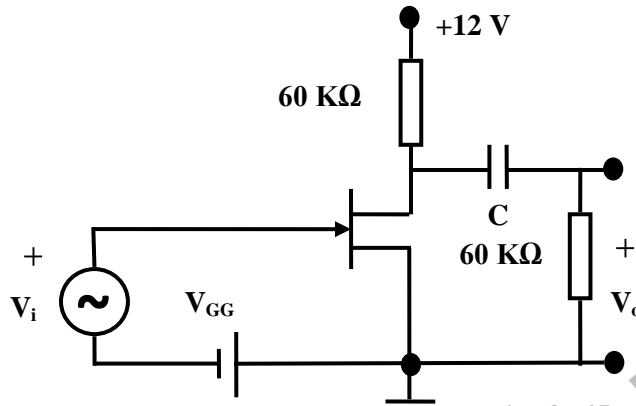


Fig. Q.45

- (A) -30
- (B) -10
- (C) +4
- (D) +60

46. The value of  $V_0$  in the circuit, shown in the figure is

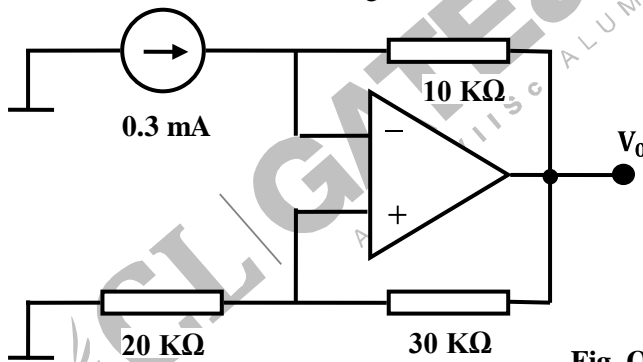
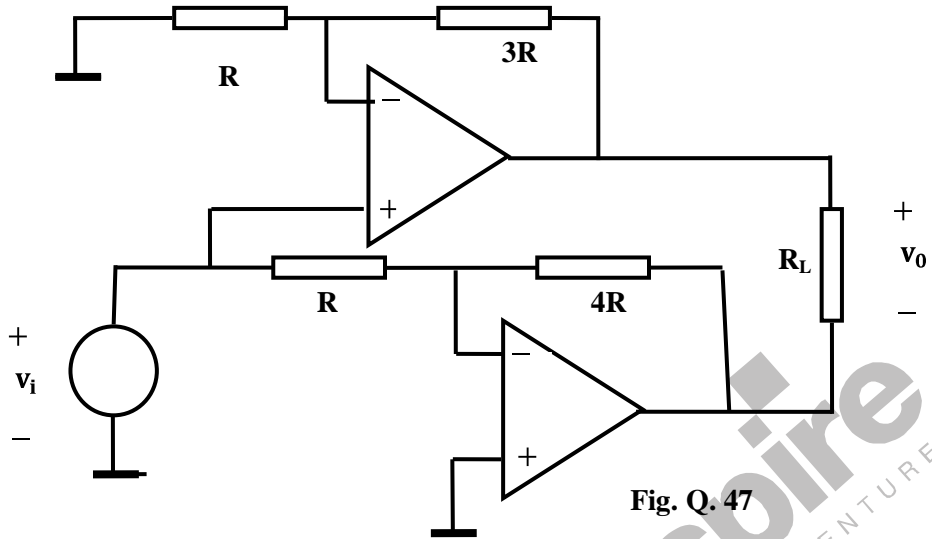


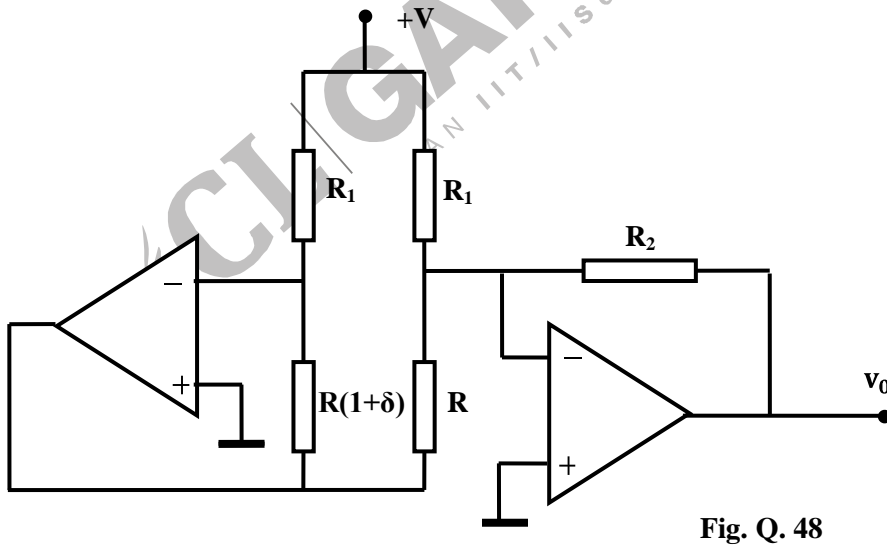
Fig. Q.46

- (A) -5V
- (B) -3V
- (C) +3V
- (D) +5V

47. The gain  $\left(\frac{v_0}{v_i}\right)$  of the amplifier circuit shown in Figure is



- (A) 8  
 (B) 4  
 (C) -4  
 (D)  $\frac{3R_L}{R}$
48. The output voltage  $v_0$  in the circuit in the given figure is



- (A)  $\frac{R_2}{R} V\delta$   
 (B)  $\frac{R_2}{R_1} V\delta$   
 (C)  $\frac{R_2}{R_1\delta} V$   
 (D)  $\frac{R_2}{R(1+\delta)} V$

49.  $V_1$  and  $V_2$  are the input voltages of an instrumentation amplifier. The output of the instrumentation amplifier is found to be  $100(V_1 - V_2) + 10^{-4}(V_1 + V_2)$ . The gain and the common mode rejection ratio (CMRR) of the instrumentation amplifier respectively are

- (A) (50,60 dB) (C) (100,60 dB)  
 (B) (50,120 dB) (D) (100,120 dB)

50. The circuit in the given figure is a

- (A) band-pass filter with lower cut-off  $\omega_l = \frac{1}{R_1 C_1}$  and higher cut off  $\omega_H = \frac{1}{R_2 C_2}$   
 (B) band-reject filter with lower cut-off  $\omega_l = \frac{1}{R_1 C_1}$  and higher cut off  $\omega_H = \frac{1}{R_2 C_2}$   
 (C) band-pass filter with lower cut-off  $\omega_l = \frac{1}{R_2 C_2}$  and higher cut off  $\omega_H = \frac{1}{R_1 C_1}$   
 (D) band-reject filter with lower cut-off  $\omega_l = \frac{1}{R_2 C_2}$  and higher cut off  $\omega_H = \frac{1}{R_1 C_1}$

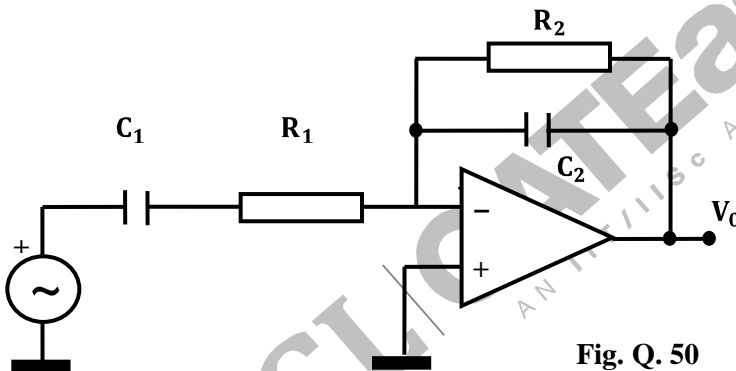


Fig. Q. 50

51. For the circuit shown in Fig. Q. 51, the diode D is ideal. The power dissipated by the 300 Ω resistor is

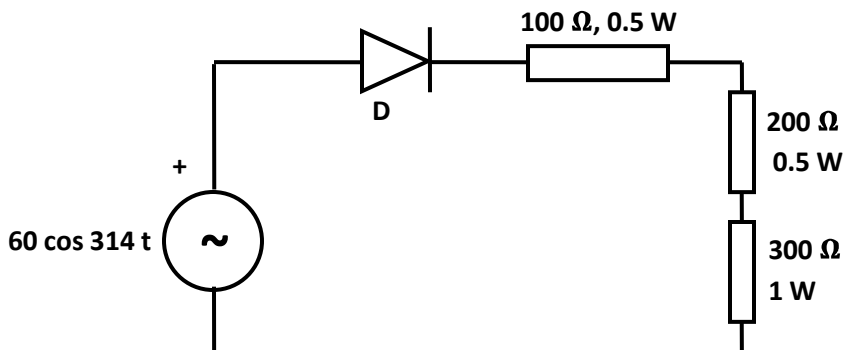


Fig. Q. 51

- (A) 0.25 W (C) 0.75 W  
 (B) 0.50 W (D) 1.00 W

52. The given figure(a) shows a Schmitt trigger circuit and figure(b) the corresponding hysteresis characteristics. The values of  $V_{TL}$  and  $V_{TH}$  are

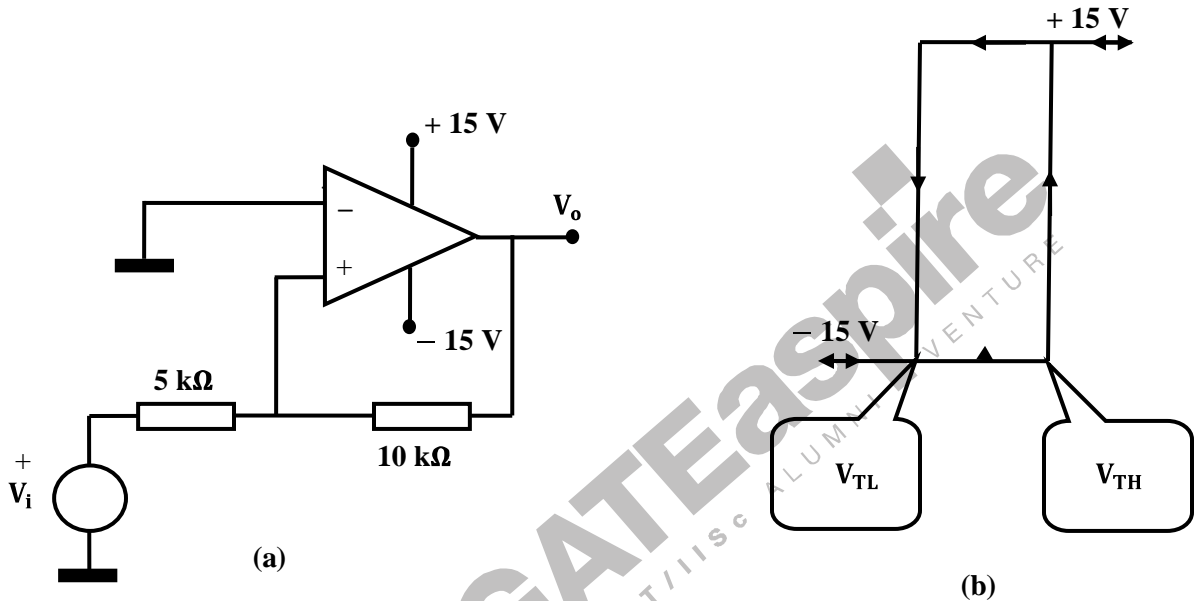


Fig. Q. 52

- (A)  $V_{TL} = -3.75\text{V}$ ,  $V_{TH} = +3.75\text{ V}$  (C)  $V_{TL} = -5\text{V}$ ,  $V_{TH} = +1\text{ V}$   
 (B)  $V_{TL} = -1\text{V}$ ,  $V_{TH} = +5\text{ V}$  (D)  $V_{TL} = -5\text{V}$ ,  $V_{TH} = +5\text{ V}$

53. The sink current of the TTL NAND gate shown in Figure is 16 mA and the input capacitance of the CMOS NAND gate is 10 pF. The minimum pull-up time constant in ns for the CMOS gate with these specifications is

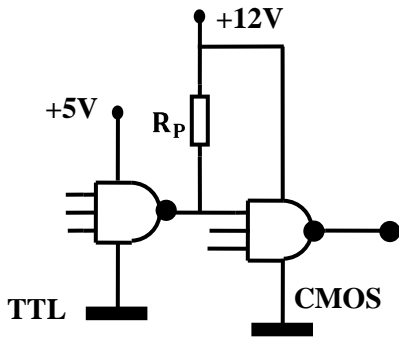


Fig. Q. 53

- (A) 10.2
- (B) 7.5
- (C) 8.5
- (D) 6.5

54. In the given figure, if the input  $C = 0$  and  $D = 0$ , the output  $Y$  can be made 0 by making

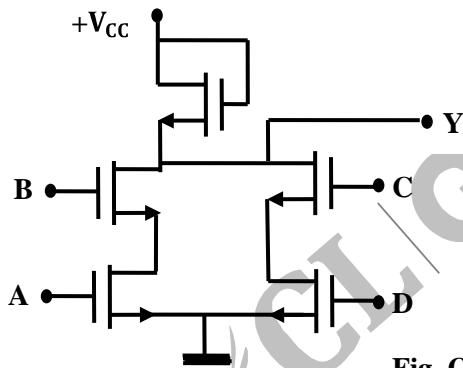


Fig. Q. 54

- (A)  $A = 0, B = 1$
- (B)  $A = 0, B = 0$
- (C)  $A = 1, B = 1$
- (D)  $A = 1, B = 0$

55. In the given figure, initially  $Q = A = B = 0$ . After three clock triggers, the states of  $Q$ ,  $A$  and  $B$  will be respectively

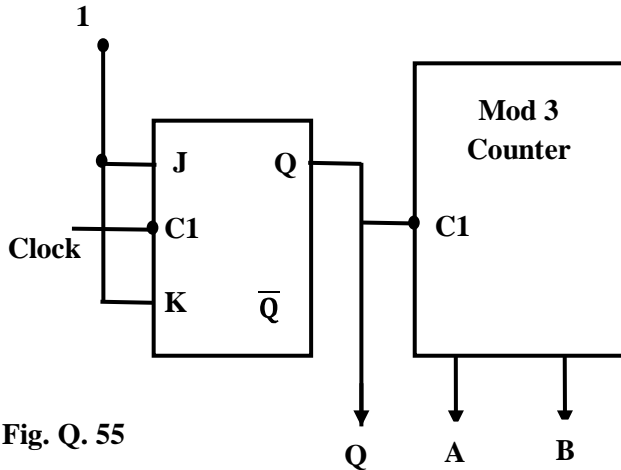


Fig. Q. 55

- (A) 110
- (B) 011
- (C) 001
- (D) 101

56. In the digital circuit shown in Q.56, the flip-flops have set time of 5 ns and a worst case delay of 15ns. The AND gate has a delay of 5 ns. Maximum possible clock rate for the circuit to operate faithfully is

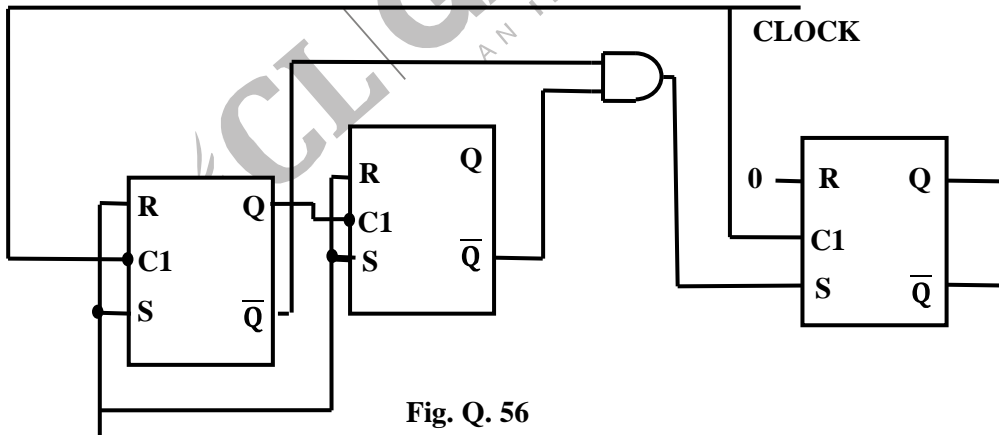


Fig. Q. 56

- (A) 21 MHz
- (B) 22 MHz
- (C) 25 MHz
- (D) 30 MHz

57.  $7E_H$  and  $5F_H$  are XORed. The output is multiplied by  $10_H$ . The result is

- (A)  $0210_H$
- (B)  $7E5F_H$
- (C)  $5F7E_H$
- (D)  $2100_H$

58. The following 8085 instructions are executed sequentially.

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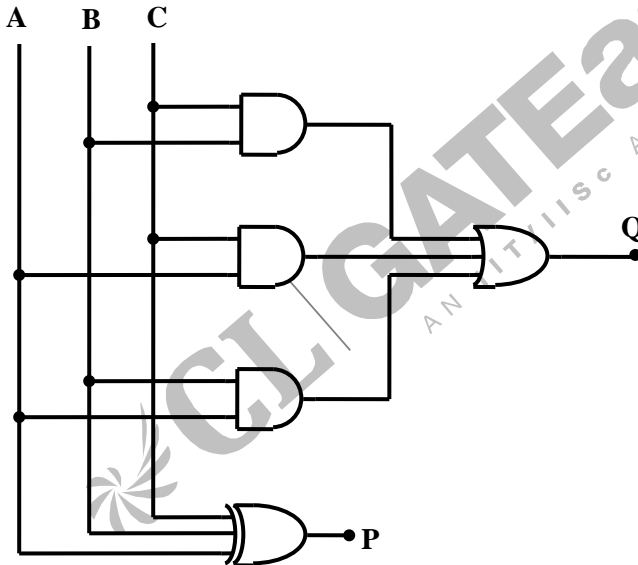
PROG:          XRA    A
              MOV    L, A
              MOV    H, L
              INX    H
              DAD    H
  
```

After execution, the content of HL register pair is

- (A) 0000H (C) 0001H  
(B) 0101H (D) 0002H

59. In the circuit of Fig. Q. 59 A, B, C are the inputs and P, Q are the two outputs. The circuit is a

- (A) half adder where P is the sum and Q is the carry  
(B) half adder where P is the carry and Q is the sum  
(C) full adder where P is the sum and Q is the carry  
(D) full adder where P is the carry and Q is the sum



60. Vectors  $\vec{x}_1 = 5i - 2j + k$  and  $\vec{x}_2 = 4i - j + 2k$  are transformed into  $\vec{y}_1 = A\vec{x}_1$  and  $\vec{y}_2 = A\vec{x}_2$ ,

using an orthogonal matrix  $A = \begin{bmatrix} 2/3 & 1/3 & 2/3 \\ -2/3 & 2/3 & 1/3 \\ 1/3 & 2/3 & -2/3 \end{bmatrix}$ . The cosine of the angle between  $\vec{y}_1$  and

$\vec{y}_2$  is

- (A)  $\frac{8}{\sqrt{70}}$  (C)  $\frac{1}{\sqrt{70}}$   
(B)  $\frac{\sqrt{3}}{2}$  (D)  $\frac{1}{2}$

61. Due to an amplitude modulation by a sine wave, if the total current in the antenna increases from 4A to 4.8A the depth of modulation in percentage is  
 (A) 93.8 (C) 40.4  
 (B) 80.1 (D) 20.2

62. Given  $X(z) = \frac{1/2}{1-az^{-1}} + \frac{1/3}{1-bz^{-1}}$ ,  $|a|$  and  $|b| < 1$  with the ROC specified as  $|a| < |z| < |b|$ ,  $x[0]$  of the corresponding sequence is given by  
 (A)  $\frac{1}{3}$  (C)  $\frac{1}{2}$   
 (B)  $\frac{5}{6}$  (D)  $\frac{1}{6}$

63. A direct form implementation of an LTI system with  $H(z) = \frac{1}{1-0.7z^{-1}+0.13z^{-2}}$  is shown in the figure. The value of  $a_0, a_1$  and  $a_2$  are respectively  
 (A) 1.0, 0.7 and  $-0.13$  (C) 1.0,  $-0.7$  and 0.13  
 (B)  $-0.13$ , 0.7 and 1.0 (D) 0.13,  $-0.7$  and 1.0

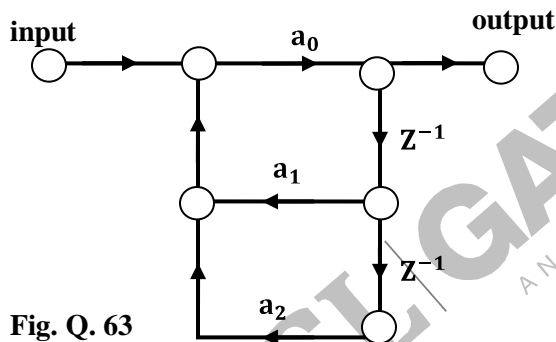


Fig. Q. 63

64. A low-pass filter has a sampling frequency  $f_T = 10 \text{ kHz}$ . The passband ( $f_p$ ) and stop band ( $f_s$ ) edge frequencies are 2 kHz and 3 kHz respectively. The frequency axis is pre-warped before applying bilinear transformation to get new angular frequencies,  $\tilde{\Omega}_p$  and  $\tilde{\Omega}_s$ . The ratio of the warped edge frequencies  $\left(\frac{\tilde{\Omega}_s}{\tilde{\Omega}_p}\right)$  is  
 (A)  $-1.213$  (C) 1.575  
 (B) 1.213 (D) 1.894
65. A casual, analog system has a transfer function  $H(s) = \frac{a}{s^2+a^2}$ . Assuming a sampling time of T seconds, the poles of the transfer function  $H(z)$  for an equivalent digital system obtained using impulse invariance method are at  
 (A)  $(e^{aT}, e^{-aT})$

- (B)  $\left(j\frac{a}{T}, -j\frac{a}{T}\right)$   
 (C)  $\left(e^{jaT}, e^{-jaT}\right)$   
 (D)  $\left(e^{\frac{aT}{2}}, e^{-\frac{aT}{2}}\right)$

66. A discrete-time signal,  $x[n]$ , suffered a distortion modeled by an LTI system with  $H(z) = (1 - az^{-1})$ ,  $a$  is real and  $|a| > 1$ . The impulse response of a stable system that exactly compensates the magnitude of the distortion is

- (A)  $\left(\frac{1}{a}\right)^n u[n]$  (C)  $a^n u[n]$   
 (B)  $-\left(\frac{1}{a}\right)^n u[-n - 1]$  (D)  $a^n u[-n - 1]$

67. A digital notch filter with a notch frequency of 60 Hz is to be transformed into one operating at a new notch frequency of 120 Hz. The sampling frequency is 400 Hz. A lowpass-to-lowpass transformation  $z^{-1} = \frac{1 - \alpha z}{z - \alpha}$  is used on the first to obtain the new notch filter. Then the value of  $\alpha$  should be

- (A) -0.95 (C) -0.46  
 (B) 0.95 (D) 0.46

68. The resistance values of the bridge circuit shown in the figure are  $R_1 = R_2 = R_3 = R$  and  $R_4 = R + \Delta R$ . The bridge is balanced by introducing a small voltage  $v$ . The value of  $\Delta R$  is

- (A)  $\frac{Rv}{E}$  (C)  $\frac{R2v}{E-2v}$   
 (B)  $\frac{Rv}{E-v}$  (D)  $\frac{Rv}{E+2v}$

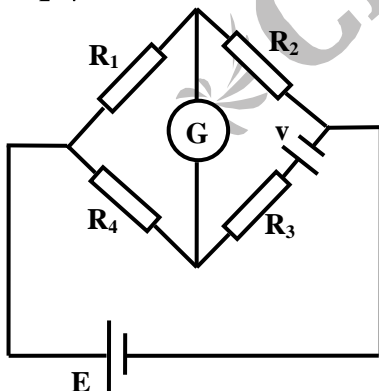
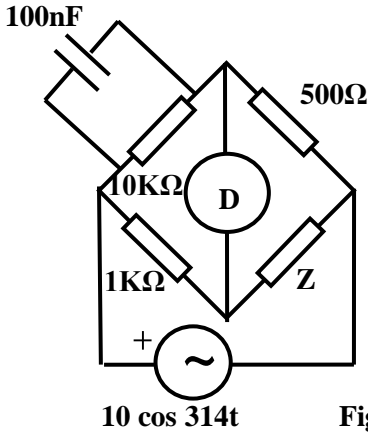
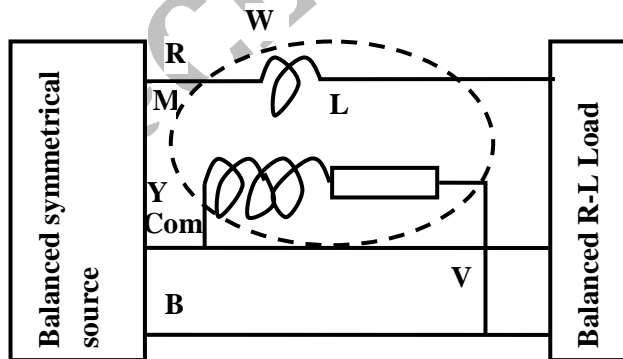


Fig. Q. 68

69. In the ac bridge shown in the figure the detector D reads zero. Then Z is made of
- (A) 50 mH in parallel with  $50\Omega$
  - (B) 50 mH in series with  $50\Omega$
  - (C) 50 nF in series with  $10\text{K}\Omega$
  - (D) 50 nF in parallel with  $5\text{K}\Omega$



70. A 3-phase balanced R-L load is connected to a 3-phase balanced symmetrical 400V, 50 Hz, RYB sequence mains as shown in Fig Q. 70. The wattmeter W reads 1.732 kW. Then
- (A) the active power in the load is 1.732kW
  - (B) the reactive power of the load is 1.732 kVAr
  - (C) the active power in the load is 3 kW
  - (D) the reactive power of the load is 3 kVAr



71. An unknown impedance  $Z$  is shunted across an ac current source of value  $2\cos(10t)$  A. The current source develops a voltage of  $\sqrt{2} \sigma \cos(10t + 45^\circ)$  V. The value of the impedance is  
 (A)  $3\Omega$  resistance in series with 0.3 H inductor  
 (B)  $3\Omega$  resistance in parallel with 0.3 H inductor  
 (C)  $3\Omega$  resistance in series with 0.3 F capacitor  
 (D)  $3\Omega$  resistance in parallel with 0.3 F capacitor
72. An ideal diode has been connected across a  $10\Omega$ , 100 mA, center-zero PMMC meter as shown in Fig. Q. 72. The meter will read

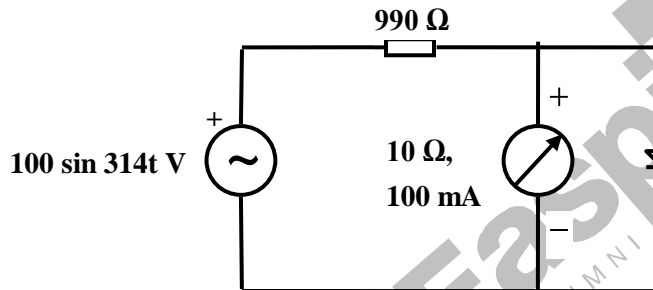
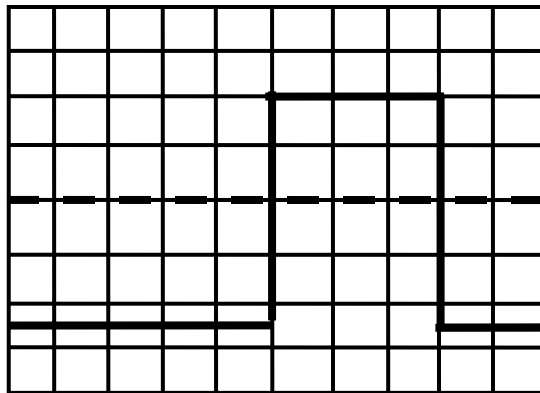


Fig Q. 72

- (A) + 100 mA  
 (B) + 31.8 mA  
 (C) -31.8 mA  
 (D) -67.3 mA
73. A wire potentiometer of length 11 m and resistance  $1\Omega/\text{m}$  balances a standard cell voltage of 1.018 V at a length of 10 m 18 cm. If the voltage of the battery supplying the current through the potentiometer is 2.0V, then the value of the series resistance connected to the potentiometer is  
 (A)  $9\Omega$   
 (B)  $90\Omega$   
 (C)  $900\Omega$   
 (D)  $990\Omega$
74. A Q-meter having an insertion resistance of  $0.02\Omega$  is used to measure the inductance of a coil. Resonance occurs at an angular frequency of  $10^6$  rad/s with a capacitance of 40 pF. The inductance of the coil is  
 (A)  $250\mu\text{H}$   
 (B) 2.5 mH  
 (C) 25 mH  
 (D) 0.25 H
75. A symmetrical square wave of frequency 25 kHz and a peak-to-peak amplitude of 10 V is fed to Y-input of a single channel oscilloscope. The screen appears as shown in Fig. Q. 75. Then the X and Y sensitivities and the trigger setting respectively are

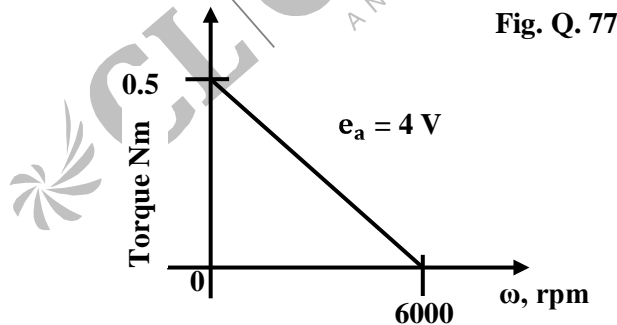


- (A) 5  $\mu\text{s/cm}$ , 2V/cm and + ve slope
- (B) 5  $\mu\text{s/cm}$ , 2V/cm and - ve slope
- (C) 10  $\mu\text{s/cm}$ , 1V/cm and + ve slope
- (D) 20  $\mu\text{s/cm}$ , 2V/cm and - ve slope

76. A certain system exhibited an overshoot of 16% when subjected to an input of  $2u(t)$ , where  $u(t)$  is a step input. The damping ration and decay ratio respectively are

- (A) (0.8, 0.0810)
- (B) (0.5, 0.0256)
- (C) (1.0, 0.1626)
- (D) (1.1, 0.0089)

77. The torque-speed curve of a constant field armature controlled DC servomotor is shown in Fig. Q. 77. The armature resistance in  $\Omega$  and torque constant in Nm/A of the motor respectively are

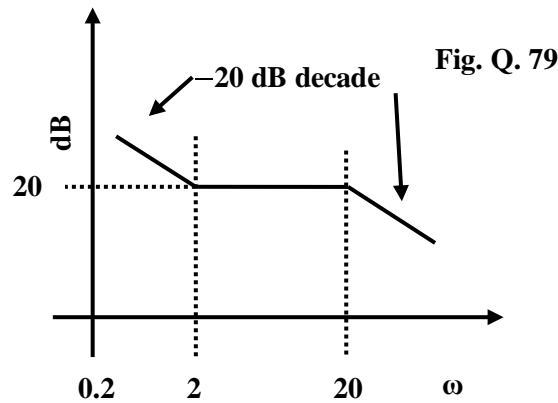


- (A) (1.76, 0.68)
- (B) (1.76, 0.85)
- (C) (2.00, 0.25)
- (D) (0.01, 0.81)

78. A certain closed loop system with unity feedback has the forward path transfer function given by  $G(s) = \frac{K}{s(s+1)(s+5)}$ . With the gain set at the ultimate value, the system will oscillate at an angular frequency of

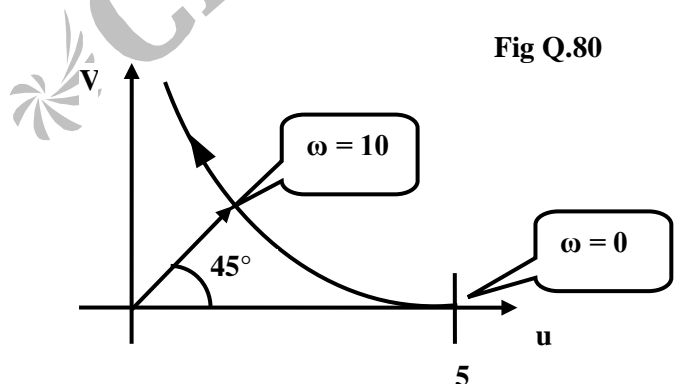
- (A)  $\sqrt{6}$  rad/s
- (B)  $\sqrt{5}$  rad/s
- (C)  $\sqrt{2}$  rad/s
- (D)  $\sqrt{3}$  rad/s

79. Fig. Q. 79 shows the Bode magnitude plot of a system. The minimum phase transfer function of the system is given by



- (A)  $\frac{80(\frac{s}{2}+1)}{s(\frac{s}{20}+1)}$
- (B)  $\frac{20(\frac{s}{2}+1)}{s(\frac{s}{20}+1)}$
- (C)  $\frac{8(s+2)}{s(s+20)}$
- (D)  $\frac{8(s+2)}{s(s+20)}$

80. Fig Q. 80 shows the polar plot of a system. The transfer function of the system is



- (A)  $5(1 + 0.1s)$
- (B)  $(1 + 0.5s)$
- (C)  $5(1 + 10s)$
- (D)  $5(1 + s)$

81. The loop transfer function of a system is given by  $G(s) = \frac{e^{-0.1s}}{s}$ . The phase crossover frequency is given by

- (A)  $\frac{\pi}{2}$  (C)  $\frac{\pi}{0.2}$   
 (B)  $\frac{\pi}{10}$  (D)  $\frac{\pi}{4}$

82. Consider the following systems:

System 1:  $G(s) = \frac{1}{(2s+1)}$       System 2:  $G(s) = \frac{1}{(5s+1)}$

The true statement regarding the system is

- (A) Bandwidth of system 1 is greater than the bandwidth of system 2  
 (B) Bandwidth of system 1 is lower than the bandwidth of system 2  
 (C) Bandwidth of both the systems are the same  
 (D) Bandwidth of both the systems are infinite

83. A state space representation for the transfer function  $\frac{y(s)}{u(s)} = \frac{s+6}{s^2+5s+6}$  is  $\dot{x} = Ax + Bu$ , where

$A = \begin{bmatrix} 0 & 1 \\ -6 & -5 \end{bmatrix}$ ,  $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ , and the value of  $C$  is  $y = Cx$

- (A)  $\begin{bmatrix} 1 \\ 2 \end{bmatrix}$  (C)  $\begin{bmatrix} 1 & 2 \\ -1 & 0 \end{bmatrix}$   
 (B)  $[6 \ 1]$  (D)  $[1 \ -5]$

84. The transmittance of a particular solution measured is  $T$ . The concentration of the solution is now doubled. Assuming that Beer-Lambert's law holds good for both the cases, the transmittance for the second would be

- (A)  $\frac{T}{2}$   
 (B)  $2T$   
 (C)  $T^2$   
 (D)  $\sqrt{T}$

85. In Fick's method of cardiac output measurement, oxygen consumption is 200 ml/ min., arterial oxygen content is 0.30 ml/ml and venous oxygen content is 0.20 ml/ml. The cardiac output in l/min. is

- (A) 1 (C) 0.5  
 (B) 2 (D) 1.5

86. A He-Ne laser of cavity length 500 mm has an oscillating bandwidth of 1500 MHz. The maximum number of longitudinal oscillating modes that is accommodated within the bandwidth is
- (A) 4 (C) 30  
(B) 5 (D) 40
87. A step index fiber has a core refractive index of 1.46 and a cladding refractive index of 1.45. The pulse dispersion in ns/km due to the effect of numerical aperture alone is
- (A) 33.6 (C) 29.5  
(B) 31.5 (D) 25.2
88. The time taken by an ionized atom, of mass  $m$  kg and charge  $e$  Coulombs, pulsed into a field-free region with  $V$  volts, to reach a detector  $L$  meters away is
- (A)  $\frac{1}{L} \sqrt{\frac{m}{2eV}}$  (C)  $m \sqrt{\frac{m}{2eV}}$   
(B)  $L \sqrt{\frac{m}{2eV}}$  (D)  $\frac{2}{L} \sqrt{\frac{m}{2eV}}$
89. In a Michelson's interferometer illuminated by a coherent and quasi-monochromatic light source, a very small frequency shift is introduced in the light returning from one of the arms. The effect on the observed fringe pattern is
- (A) a decrease in contrast  
(B) an increase in contrast  
(C) appearance of two sets of the same pattern  
(D) uniform movement across the observation plane
90. In an ideal X-Ray tube operated at 40 kV, the short wavelength limit of X-Ray emission in  $\text{\AA}$  is (Planck's constant  $h = 6.626 \times 10^{-34} \text{ Js}$ , Charge of an electron  $e = 1.6 \times 10^{-19} \text{ Coulomb}$ , velocity of light  $C = 3 \times 10^8 \text{ m/s}$ )
- (A) 0.155 (C) 0.62  
(B) 0.31 (D) 0.93