# VANI INSTITUTE GATE/IES

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## GATE 2015 EXAMINATION

INSTRUMENTATION ENGINEERING

**Section Name: General Aptitude**

01. Choose the appropriate word phase, out of the four options given below to complete the following sentence.

Apparent lifelessness_____ dormant life

a) Harbours b) leads to c) Supports d) Affects

**Ans : b**

02. Five terms have to compete in a league, with every team playing every other team exactly once, before going to the next round, how many matches will have to the held to complete the league rounds of matches?

a) 20 b) 10 c) 8 d) 5

**Ans : b**

03. Tanya is older than Eric

Cliff is older than Tanya

Eric older than cliff

If the first sentence are true, then the third statement is

a) True b) False c) uncertain d) Data in sufficient

**Ans : b**

04. Choose the statement where underlined word is used correctly

a) When the teacher eludes two different authors, he is being elusive

b) When the thief keeps eluding the police, he is being elusive

c) Matters that are difficult to understand, identify or remember or allusive

d) Mirages can be allusive but a better way to express then is illusory

**Ans : b**

05. Fill in the blanks with correct idioms phrase.

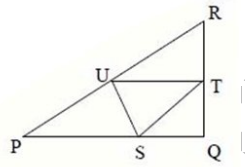
That boy from town was a _____ in the sleepy village

a) dog out of herd b) sheep from the heap

c) fish out of water d) bird from the flock

**Ans : c**

06. In the given figure angle Q is a right angle, PS :PS =3:1, RT : QT =5:1, and PU:UR = 1:1 if area of triangle QTS is 20 $cm^2$ then area of triangle PQR in $cm^2$ is _____




Ans : 280

07. Given below are tow statements followed by two conclusions. Assume these statements to be true decide which one logically follows

**Statements**

I. No manager is a leader

II. All readers are executives

**Conclusions**

I. No manager is an executive

II. No executive is a manager

a) Only Conclusion I fallows b) Only conclusion two fallows

c) Neither conclusion I nor II follows d) Both conclusions I and II fallows

**Ans : c**

08. A coin is tossed trice let X be the even that occurs in each of the first two tosses. Let Y be the event that a tail occurs on the third toss. Let Z be the event that two tails occurs in the three tosses .

Based on the above information which one of the statement is True

a) X and Y are not independent b) Y and Z are dependent

c) Y and Z are independent d) X and Z are independent

**Ans : b**

09. Select the appropriate options in place of underlined part of the sentence.

Increase productivity necessary reflects greater than efforts made by the employees

a) Increase in productivity necessary
b) Increase productivity is necessary
c) Increase in productivity necessarily
d) No implement require

**Ans : c**

10. Right angle PQR is to be constructed in the XY – plane so that the right angle is at a P and line PR is parallel the X axis the x and y coordinates of PQ and R to be integers that satisfy the inequalities : $-4 \leq X \leq 5$ and $6 \leq Y \leq 16$ how many different triangles could be constructed with these properties?

a) 110 b) 1100 c) 9900 d) 10000

**Ans : c**

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## INSTRUMENTATION ENGINEERING

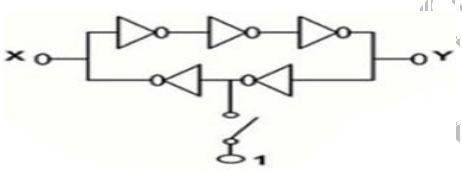
01. The bridge most suited for measurement of a four-terminal resistance in he range of 0.001Ω to 0.1Ω is

a) Wien's bridge b) Kelvin double bridge

c) Maxwell's' bridge d) Schering bridge

**Ans : b**

02. In the circuit shown, th switch is momentarily closed and then opened. Assuming the logic gates to have equal non-zro delay, at steady state, the logic states of X and Y are




a) X is latched, Y toggles continuously b) X and Y are both latched

c) Y is latched, X toggles continuously d) X and Y both toggle continuously

**Ans : d**

03. The voltage ($E_Q$) developed across a glass electrode for pH measurement is related o the temperature *(T)* by the relation

a) $E_0 \alpha \frac{1}{T^2}$ b) $E_0 \alpha \frac{1}{T}$ c)$E_0 \alpha T$ d) $E_0 \alpha T^2$

**Ans : c**

04. The double integral $\int_0^x \int_0^y (x,y)\,dx\,dy$

a) $\int_0^x \int_0^y (x,y)\,dx\,dy$ b) $\int_0^a \int_x^y f(x,y)\,dx\,dy$

**c)** $\int_0^a \int_x^a f(x,y)\,dy\,dx$ d) $\int_0^a \int_x^a f(x,y)\,dx\,dy$

**Ans : c**

05. The torque transmitted by a cylindrical shaft is to be measured by using two strain gauges. The angles from mounting the strain gauges relative to the axis of the shaft for maximum sensitivity are

a) $\pm 45^0$ b) $\pm 60^0$ c) $\pm 90^0$ d) $\pm 180^0$

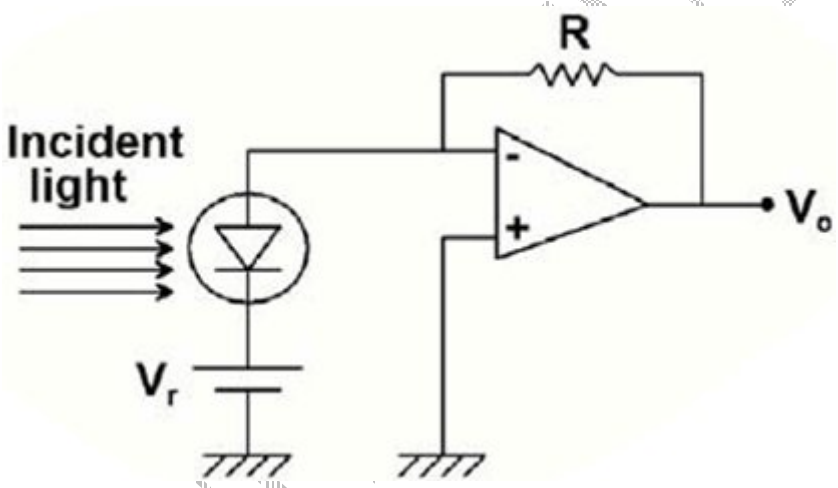
**Ans : c**

06. A mass-spring –damper system with force as input and displacement of the mass as output has a transfer function $G(s)=1/(s^2+24s+900)$. A force input $F(t)=10\sin(70t)$ newtons is applied at time $\tau$ = 0 s. A beam from an optical stroboscope is focused on the mass. In steady state, the strobe frequency in hertz at which the mass appears to be stationary is

a) 5/π b) 15/π c) 35/ π d) 50/ π

**Ans : b**

07. A light detector circuit using an ideal photo-diode is shown in the figure. The sensitivity for the photo-diode is 0.5μA/μW. with $V_r$=6V, the output voltage $V_0$=-1.0V for 10μW of incident light. If $V_r$ is changed to 3V, keeping all other parameters the same, the value of $V_0$ in volts is_____V.




**Ans : -1.0**

08. The highest frequency present in the signal x(t) is $f_{max}$. The highest frequency presents in the signal $y(t)=x^2(t)$ is

a) $\frac{1}{2}f_{max}$ b) $f_{max}$ c)$f_{max}$ d) $4f_{max}$

**Ans : c**

09. Let A be an a x n matrix with rank (0<r<n). Then Ax=0 has *p* independent solutions. Where *p* is

a) r b) n c) n-r d) n+r

**Ans : a**

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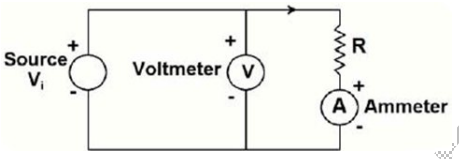
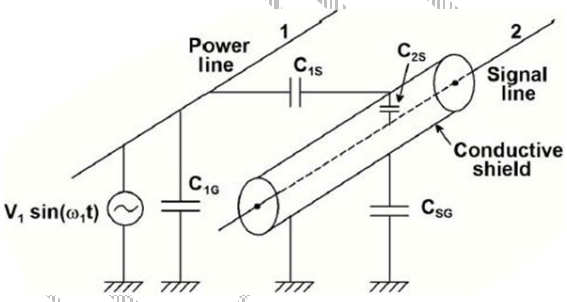
10. Consider the ammeter –voltmeter method of determining the value of the resistance R using the circuit shown in the figure. The maximum possible errors of the voltmeter and ammeter are known to be 1% and 2% of their readings, respectively Neglecting the effects of meter resistances, the maximum possible percentage error in the value of R determined from the measurements, is _____%.




Ans : 3

11. A power line is coupled capacitively through various parasitic capacitances to a shielded signal line as shown in the figure. The conductive shield is grounded solidly at one end. Assume that the length of the signal wire extentended beyond the shield. And the shield resistance is negligible. The magnitude of the noise voltage coupled to the signal line is .




a) Directly proportional to $C_{1G}$
b) Inversely proportional to the power line frequency
c) Inversely proportional to $C_{is}$
d) Zero

**Ans : D**

12. Liquid flow rate is measured using

a) a Pirani gauge b) a pyrometer c) an orifice plate d) a bourdon tube

**Ans : c**

13. The filter whose transfer function is of the from $G(s)=\dfrac{s^2-bs+c}{s^2+bs+c}is$

a) a high – pass filter b) a low-pass filter c) an all-pass filter d) a band-reject filter

**Ans : c**

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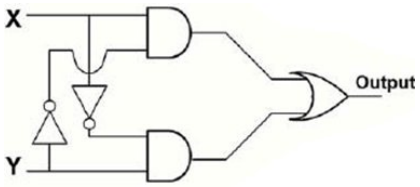
14. The logic evaluated by the circuit at the output is




a) $X\overline{Y}+Y\overline{X}$ b) $\left(\overline{X+Y}\right)XY$ c) $\overline{XY}+XY$ d) $\overline{X}Y+X\overline{Y}+X+Y$

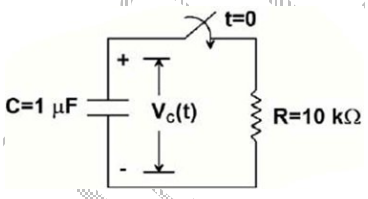
Ans : a

15. The magnitude of the directional derivative of the function $f(x,y)=x^2+3y^2$ in a direction normal to the circle $x^2+y^2=2$, at the point (1,1),is

a)$4\sqrt{2}$ b) $5\sqrt{2}$ c) $7\sqrt{2}$ d) $9\sqrt{2}$

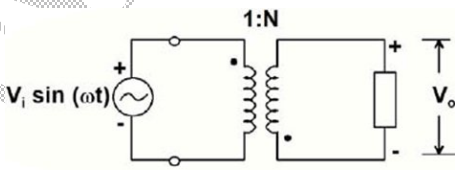
**Ans : a**

16. The capacitor shown in the figure is initially charged to 10V. The switch closes at time $\tau$ =0. Then the value of $V_C(t)$ in volts at time $\tau$ =10 ms is_____V.




Ans : 3.678

17. The output voltage of the ideal transformer with the polarities and dots shown in the figure is given by




a) $NV_i\sin\omega t$ b) $-NV_i\sin\omega t$ c) $\frac{1}{N}V_i\sin\omega t$ d) $-\frac{1}{N}V_i\sin\omega t$

Ans : b

18. A System with transfer function $G(s)=\frac{1}{s^2+1}$ has zero initial conditions. The percentage overshoot in its step response is _____%.

**Ans:100**

19. A p-type semiconductor strain gauge has a nominal resistance of 1000Ω and a gauge factor of +200 at $25^0$C. The resistance of the strain gauge in ohms when subjected to a strain of $+10^{-4}$m/m at the same temperature is_____Ω.

**Ans : 1020**

20. An apparatus to capture ECG signals has a filter followed by a data acquisition system. The filter best suited for this application is

a) Low pass with cutoff frequency 200Hz

b) High pass with cutoff frequency 200Hz

c) band pass with lower and upper cutoff frequencies 100Hz and 200Hz for its pass band

d) Band reject with lower and upper cutoff frequencies 1Hz and 200Hz for it stop band

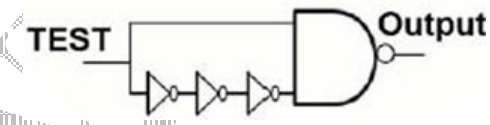
**Ans : a**

21. The value of $\oint \frac{1}{Z^2} dz$. Where the contour is the unit circle traversed clockwise, is

a) -2πi b) 0 c) 2πi d)4πi

**Ans : b**

22 Consider the logic circuit with input signal TEST shown in the figure. All gates in the figure shown have identical non-zero delay. The signal TEST which was at logic LOW is switched to logic HIGH and maintained at logic HIGH. The output




a) Stays HIGH throughout

b) Stays LOW throughout

c) Pulses from LOW to HIGH to LOW

d) Pulses from HIGH to LOW to HIGH

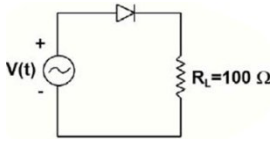
**Ans : a**

23. Let 3+4j be a zero of a fourth order linear-phase FTR filter. The complex number which is NOT a zero of this filter is

a) $3-4j$ b) $\frac{3}{25}+\frac{4}{25}j$ c) $\frac{3}{25}-\frac{4}{25}j$ d) $\frac{1}{3}-\frac{1}{4}j$

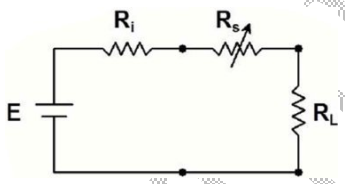
**Ans: d**

24. The figure shows a half-wave rectifier circuit with input voltage V(t)=10sin (100πt) volts. Assuming ideal diode characteristics with zero forward voltage drop and zero reverse current, the average power consumed in watts by the load resistance $R_L$ is _____W.




**Ans : 0.1013**

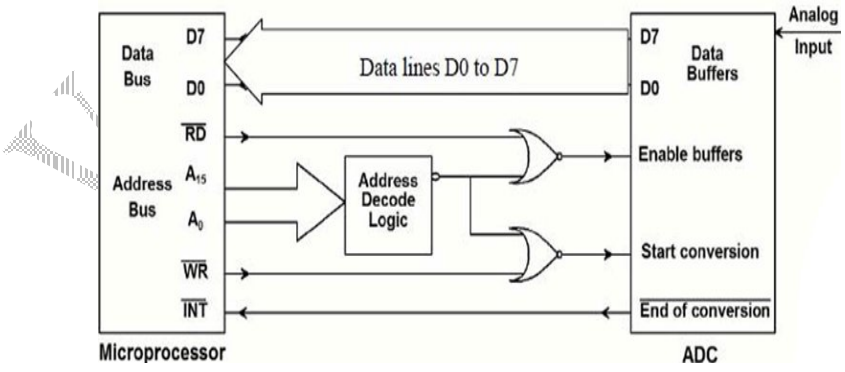
25. A load resistor $R_L$ is connected to a battery of voltage E with internal resistance $R_i$ through a resistance $R_S$ as shown in the figure. For fixed values of $R_L$ and $R_i$ the value of $R_S(\geq 0)$ ia maximum power transfer to $R_L$ is




a) 0 b) $R_L$-$R_i$ c)$R_L$ d) $R_L$-$R_i$

**Ans : a**

26. An ADC is interfaced with a microprocessor as shown in the figure. All signals have been indicated with typical notations. Acquisition of one new sample of the analog input signal by the microprocessor involves.




a) One READ cycle only
b) One WRITE cycle only
c) One WRITE cycle followed by REAC cycle
d) One READ cycle followed by one WRITE cycle

**Ans : c**

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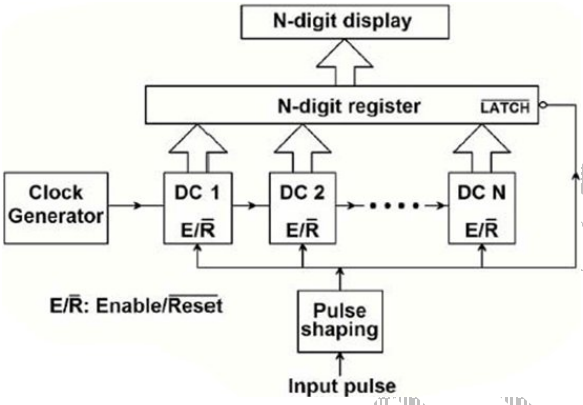
27. The number of clock cycles for the duration of an input pulse is counted using a cascade of N decade counters (DC1 to DC N) as shown in the figure. IF the clock frequency in mega hertz is *f*. the resolution and range of measurement of input pulse width, both in μs, are respectively.




a) $\frac{1}{f}$ *and* $\frac{\left(2^N-1\right)}{f}$

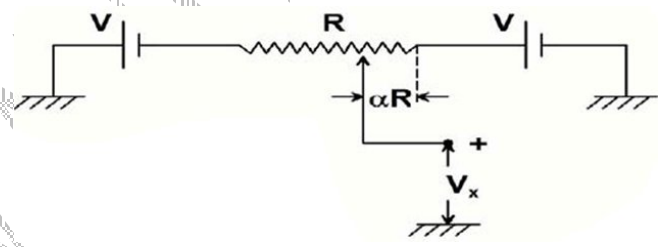
b) $\frac{1}{f}$ *and* $\frac{\left(10^N-1\right)}{f}$

c) $\frac{10^N}{f}$ *and* $\frac{\left(10^N-1\right)}{f}$

d) $\frac{2^N}{f}$ *and* $\frac{\left(2^N-1\right)}{f}$

**Ans : b**

28. in the potentiometer circuit shown in the figure, the expression for $V_X$ is




a)(1-2α)V b) (1- α)V c) (α-1)V d) αV

**Ans : a**

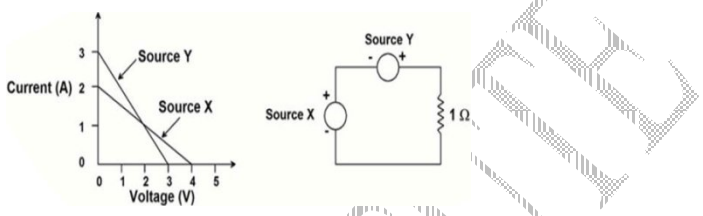
29. The fundamental period of the signal $x(t)=2\cos\left(\frac{2\pi rt}{3}\right)+\cos\left(\pi t\right)$, in seconds, is_____s.

**Ans : 6**

30. A beam of monochromatic light passes through two glass slabs of the same geometrical thickness at normal incidence. The refractive index, of the first slab is 1.5 and that of the second, 2.0. The ratio of the time of passage of the beam through the first to the second slab is _____.

**Ans : 0.75**

31. The linear 1-V characteristics of 2-terminal non-ideal dc sources X and Y are shown in the figure. If the sources are connected to 1Ω resistor as shown, the current through the resistor in amperes is _____A.




**Ans : 1.75A**

32. The open loop transfer function of a system is $G(s)=\frac{s^2+6s+10}{s^2+2s+2}$. The angles of arrival of its root loci are

a) $\pm\frac{\pi}{4}$ b) $\pm\frac{\pi}{3}$ c) $\pm\frac{\pi}{2}$ d) $\pm\frac{5\pi}{6}$

**Ans : C**

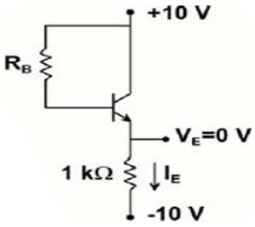
33. The output frequency of an *LC* tank oscillator employing a capacitive sensor acting as the capacitor of the tank is 100kHz. If the sensor capacitance increases by 10%. The output frequency in kilo-hertz becomes_____kHz.

**Ans : 95.34**

34. The probability density function of a random variables $X$ *is* $px(x)=e^{-x}$ *for* $x\geq 0$ and 0 otherwise. The expected value of the function $_{gx}(x)=e^{3\pi/4}$ is_____.

**Ans : 4**

35. In the circuit shown in the figure, it is found that $V_{BE}$=0.7 V and $V_E$=0.V. if $\beta_{dc}$ =99 for the transistor, then, then the value of $R_B$ in kilo ohms is_____kΩ.



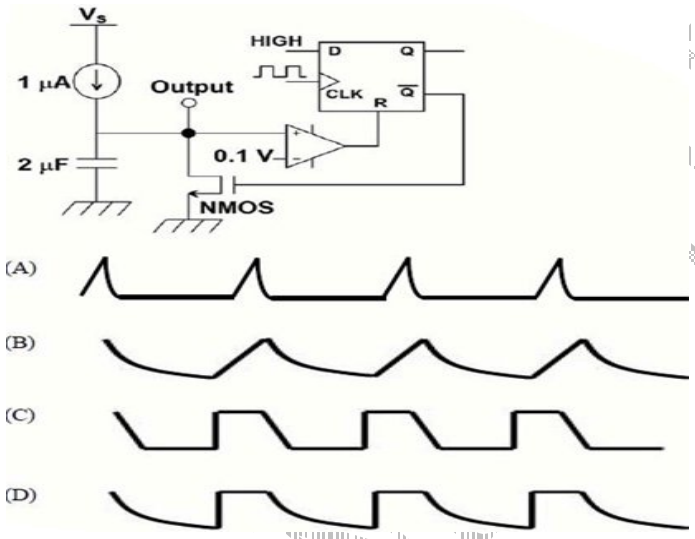

**Ans : 93**

36. Consider a low-pass filter module with a pass-band ripple of $\delta$ in the gain magnitude. If $M$ such identical modules are cascaded, ignoring the loading effects. The pass-band ripple of the cascade is

a) $1-(1-\delta)^M$ b) $\delta^M$ c) $(1-\delta^M)$ d) $(1-\delta)^M$

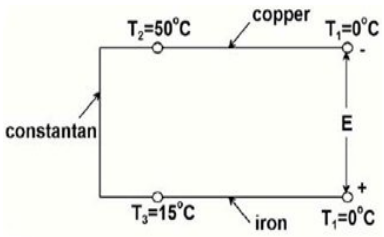
**Ans : --**

37. For the circuit shown in the figure. The rising edge triggered D-flip flop with asynchronous reset has a clock frequency of 1Hz. The NMOS transistor has an ON resistance of 1000Ω and an OFF resistance of infinity. The nature of the output waveform is



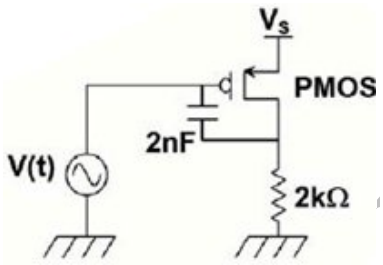

**Ans : A**

38. The Seebeck coefficients, in $\mu V/^0C$, for copper, constantan and iron, with respect to platinum, are 1.9-38.3 and 13.3, respectively. The magnitude of the thermo emf E developed in the circuit shown in the figure, in millivolts is_____ mV.



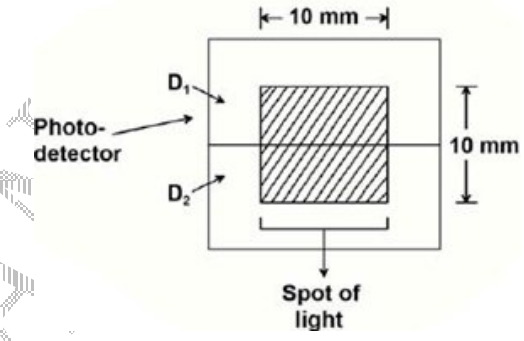

**Ans : -1.839**

39. In the circuit shown, the voltage source (t) = 1+0.1 sin(100t)volts. The PMOS transistor is biased such that it is saturation with its gate-source capacitance being 4nF and its transconductance at the operating point being 1mA/V. Other parasitic impedances of the MOSFET may be ignored. An external capacitor of capacitance 2 nF is connected across the PMOS transistor as shown. The input impedance in mega olim as seen by the voltage source is _____MΩ.



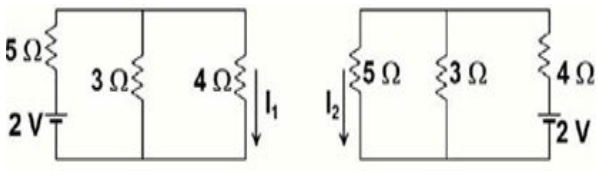

**Ans : 1.67**

40. The figure shows a spot of light uniform intensity 50W/m$^2$ and size 10mm x 10 mm incident at the exact center of a photo-detector, comprising two identical photo – diodes $D_1$ and $D_2$. Each diode has a sensitivity of 0.4 A/W and is operated in the photoconductive mode. If the spot of light is displaced upwards by 100μm. the resulting difference between the photocurrents generated by $D_1$ and $D_2$ in micro amperes, is _____μA.



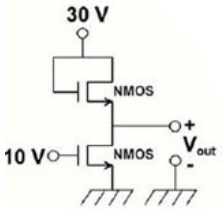

**Ans : 40**

41. Consider the circuits shown in the figure. The magnitude of the ratio of the currents. i.e, $|I_1 / I_2|$, is_____.



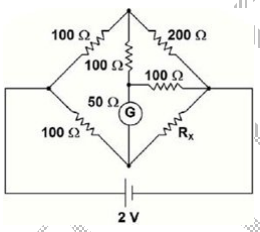

**Ans : 1**

42. In the circuit shown in the figure. Both the NMOS transistors are identical with their threshold voltages being 5V ignoring channel length modulation, the output voltage $V_{out}$ in volt is _____V.




**Ans : 0**

43.If the deflection of the galvanometer in the bridge circuit shown in the figure is zero, then the value of $R_X$ in ohms is _____Ω.

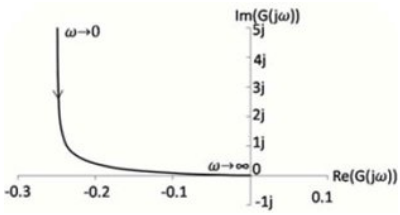



**Ans : 50**

44. A system is represented in state-space as X=AX+Bu, where A=$\begin{bmatrix} 1 & 2 \\ \alpha & 6 \end{bmatrix}$ and B=$\begin{bmatrix} 1 \\ 1 \end{bmatrix}$.The value of α for which the system is not controllable is _____.

**Ans : -3**

45. A Transfer function G(s) with degree of its numerical polynomial zero and degree of its denominated polynomial two has a nyquist plot shown in the figure. The transfer function represents




a) A stable type-0 system
b) A stable type-1 system
c) An unstable type-0 system
d) An unstable type-1 system

**Ans : d**

46. The resolving power of a spectrometer consisting of a collimator a grating telescope can be increased by

a) Increasing the angular magnification of the telescope

b) Increasing the period of the grating

c) Decreasing the period of the grating

d) Decreasing the slit – width of the collimator

**Ans : d**

47. The Z – transform of $x[n]=\alpha^{|n|}, 0<|\alpha|<1$, *is* $X(z)$. The region of convergence of X(x) is

a) $|\alpha|<|z|<\frac{1}{|\alpha|}$

b) $|z|>\alpha$

c) $|z|>\frac{1}{|\alpha|}$

d) $|z|<\min[|1\alpha|,\frac{1}{(\alpha)}]$

**Ans : a**

48. The signal x(n)= sin(πn/6)/(πn) is processed through a linear filter with the impulse response of h(n)= sin($\omega_c$n)/( πn) where$\omega_c$> π/6. The output of the filter is.

a) sin (2$\omega_c$n)/( πn)

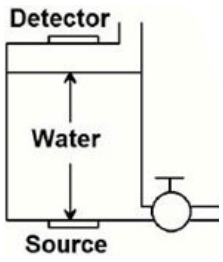
b)sin(πn/3)/ (πn)

c)[sin (πn/6)/ (πn)]$^2$

d) sin(πn/6) /(πn)

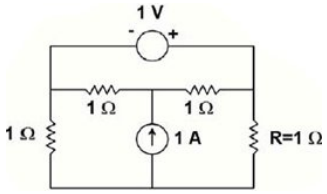
**Ans : D**

49. A liquid level measurement system employing a radio isotope is mounted on a tank as shown in the figure. The absorption coefficient of water for the radiation is 7.7m$^{-1}$. If the highest water in the tank is reduced from 100mm to 90mm. the percentages changes in the radiation insensitive received by the detector neglecting absorption of the radiation by air is _____%.




**Ans : 8**

50. The current in amperes through the resistor R in the circuit shown in the figure is _____A.

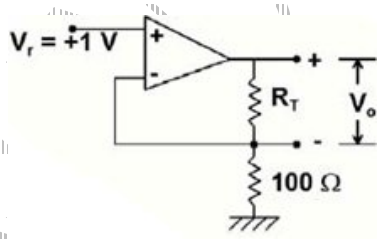



**Ans : 1**

51. A signal is band – limited to 0-12kHz the signal spectrum is corrupted by additive a noise which is band limited 0-12kHz. Theoretically the minimum rate kilohertz at which the noise signal must be sample so that the UNCORRUPTED PART of the signal spectrum can be received is _____ kHz.

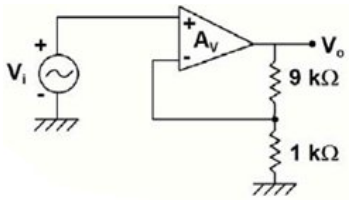
**Ans : 20**

52. in the figure shown $R_T$ represents a resistance temperature device (RTD) whose characteristics is given by $R_T = R_0 (1+\alpha t)$ where $R_0 = 100\Omega$ $\alpha = 0.0039\ ^0C^{-1}$ and T denotes the temperature $^0C$ assuming the opamp to be ideal. The value of $V_0$ in volts when $T=100^0C$ is _____V.




**Ans : 1.39**

53. An OPAPM ideal characteristic except that its open loop gain is given by the expression $A_V(S)=10^4/(1+10^{-3}s)$ this opamp is used in the circuit shown in the figure the 3-dB band width of the circuit in radius is_____.




a) $10^2$ b) $10^3$ c) $10^4$ d) $10^6$

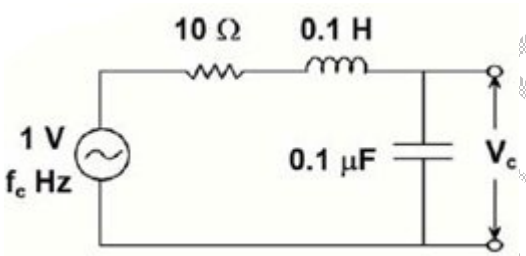
**Ans : a**

54. The probability that a thermistor randomly picked up from a production unit is defective is 0.1 the probability out of 10 thermistors randomly picked up 3 are defective is.

a) 0.001 b) 0.057 c) 0.107 d) 0.3

**Ans : b**

55. The circuit shown in the figure is in series resonance at frequency $f_C$Hz the value of $V_C$ in volts is _____ V.




**Ans : 0.707**