Gate EE-2015
SET-1

AI24BTECH11032 Shreyansh Sonkar

1) A random variable X has probability density function f(x) as given below:

$$f(x) = \begin{cases} a + bx & \text{if } 0 < x < 1, \\ 0 & \text{otherwise} \end{cases}$$

If the expected value $\mathrm{E}[X] = \frac{2}{3}$, then $\Pr[X < 0.5]$ is

2) If a continuous function f(x) does not have a root in the interval $[a, b]$ then which one of the following statements is TRUE?

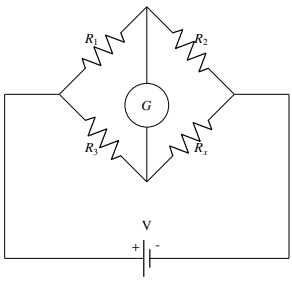
a) $f(a) \cdot f(b) = 0$
b) $f(a) \cdot f(b) < 0$
c) $f(a) \cdot f(b) > 0$
d) $\frac{f(a)}{f(b)} \leq 0$

3) If the sum of the diagonal elements of a 2×2 matrix is -6, then the maximum possible value of determinant of the matrix is _____.

4) Consider a function $\overrightarrow{f} = \frac{1}{r^2}\hat{r}$ where r is the distance from the origin and $\hat{r}$ is the unit vector in the radial direction. The divergence of this function over a sphere of radius R, which includes the origin, is

a) 0 b) 2π c) 4π d) Rπ

5) When the Wheatstone bridge shown in the figure is used to find the value of resistor R_X, the galvanometer G indicates zero current when $R_1 = 50\Omega, R_2 = 65\Omega$ and $R_3 = 100\Omega$. If R_3 is known with ±5% tolerance on its nominal value of 100Ω, what is the range of R_X in Ohms ?



a) [123.50, 136.50]
b) [125.89, 134.12]
c) [117.00, 143.00]
d) [120.25, 139.75]

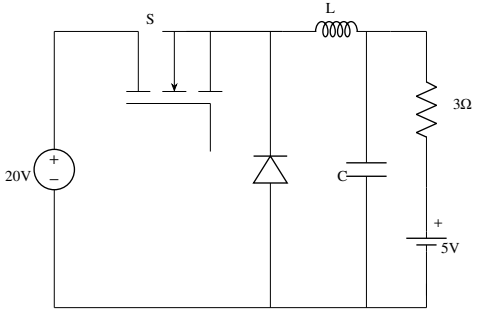
6) A (0 – 50A) moving coil ammeter has a voltage drop of 0.1V V across its terminals at full scale deflection. The external shunt resistance (in milliohms) needed to extend its range to (0 – 50A) is _____.

7) Of the four characteristics given below, which are the major requirements for an instrumentation amplifier?

P. High common mode rejection ratio
Q. High input impedance
R. High linearity
S. High output impedance

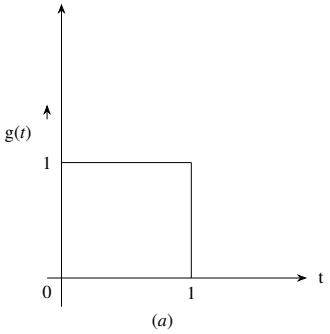
a) P, Q and R only
b) P and R only
c) P, Q and S only
d) Q, R and S only

8) In the following chopper, the duty ratio of switch S is 0.4. If the inductor and capacitor are sufficiently large to ensure continuous inductor current and ripple free capacitor voltage, the charging current (in Ampere) of the 5V battery, under steady-state,is _____.

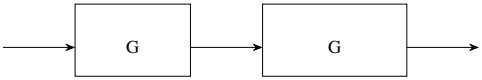


9) A moving average function is given by $y(t) = \frac{1}{T}\int_{t-T}^{t} u(\tau)\,d\tau$. If the input μ is a sinusoidal signal of frequency $\frac{1}{2T}$Hz,then in steady state, the output y will lag μ (n degree) by _____.

10) The impulse response g(t) of a system, G, is as shown in Figure (a). What is the maximum value attained by the impulse response of two cascaded blocks of G as shown in Figure (b) ?



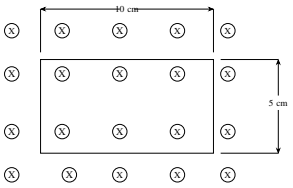
(*a*)



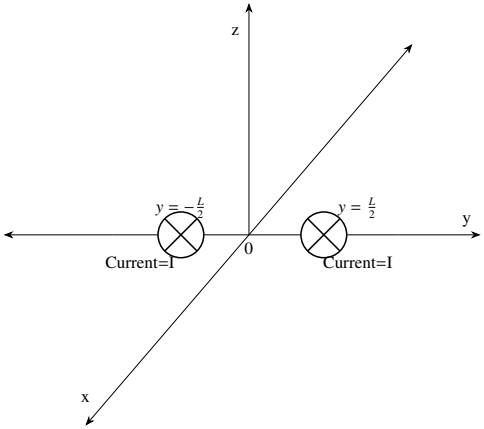
(*b*)

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

11) Consider a one-turn rectangular loop of wire placed in a uniform magnetic field as shown in the figure. The plane of the loop is perpendicular to the field lines. The resistance of the loop is 0.4Ω, and its inductance is negligible. The magnetic flux density (in Tesla) is a function of time, and is given by $B(t) = 0.25\sin\omega t$, where $\omega = 2\pi \times 50\frac{radian}{second}$. The power absorbed (n Watt) by the loop from the magnetic field is _____.



12) A steady current I is flowing in the −x direction through each of two infinitely long wires at $y = \pm\frac{L}{2}$ as shown in the figure. The permeability of the medium is μ_0 . The $\overrightarrow{B}$-field at $(0, L, 0)$ is



a) $-\frac{4\mu_0 I}{3\pi L}\hat{Z}$ b) $+\frac{4\mu_0 I}{3\pi L}\hat{Z}$ c) 0 d) $-\frac{3\mu_0 I}{4\pi L}\hat{Z}$

13) Consider the circuit shown in the figure. In this circuit R= 1kΩ, and C= 1μF. The input voltage is sinusoidal with a frequency of 50Hz,represented as a phasor with magnitude V_i and phase angle 0 radian as shown in the figure. The output voltage is represented as a phasor with magnitude V_o and phase angle δ radian . What is the value of the output phase angle δ (in radian) relative to the phase angle of the input voltage?

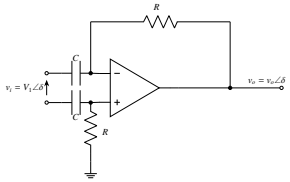


Fig. 13: Circuit diagram with capacitors, resistors, and an op-amp

a) 0 b) π c) $\frac{\pi}{2}$ d) $-\frac{\pi}{2}$