**Dhirubhai Ambani Institute of Information and Communication Technology**

# Ph.D.

## Electronics & Communication Engineering

### Sample Question Paper

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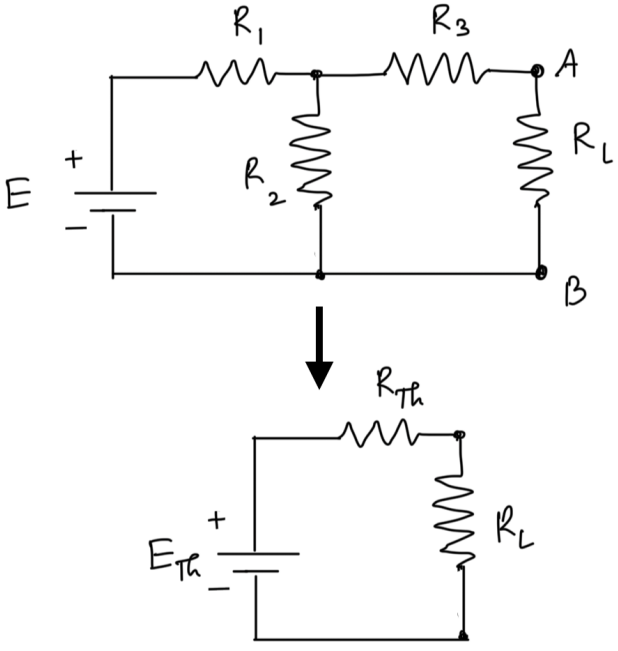
1. For the given circuit below, find Thevenin's equivalent voltage ($E_{\text{Th}}$) and Thevenin's equivalent resistance ($R_{\text{Th}}$) across the load resistance $R_l$, assuming $E = 10\ V$, $R_1 = 100\ \Omega$, $R_2 = 100\ \Omega$ and $R_3 = 150\ \Omega$




   (a) $E_{\text{Th}} = 50\ V$, $R_{\text{Th}} = 200\ \Omega$.

   (b) $E_{\text{Th}} = 5\ V$, $R_{\text{Th}} = 200\ \Omega$.

   (c) $E_{\text{Th}} = 20\ V$, $R_{\text{Th}} = 5\ \Omega$.

   (d) $E_{\text{Th}} = 200\ V$, $R_{\text{Th}} = 5\ \Omega$.

2. What is meant by reverse biasing of a PN junction?

   (a) The anode (P-type) is connected to negative terminal and cathode (N-type) to the positive terminal of the power supply

   (b) The anode (P-type) is connected to positive terminal and cathode (N-type) to the negative terminal of the power supply

   (c) Both (a) and (b)

   (d) The anode (P-type) is connected to negative terminal and cathode (N-type) to the ground

(e) None of the above

3. The drain of an n-channel MOSFET is shorted to the gate so that $V_{GS} = V_{DS}$. The threshold voltage ($V_T$) of MOSFET is 1 V. If the drain current ($I_D$) is 1 mA for $V_{GS} = 3V$, then for $V_{GS} = 5$ V, $I_D$ is

   (a) 4 mA
   (b) 5 mA
   (c) 6 mA
   (d) 8 mA
   (e) None of the above.

4. The impulse signal $\delta(n)$ is 1 for

   (a) n=1
   (b) n=-1
   (c) n=0
   (d) n=2
   (e) None of the above

5. Let the input signal denoted by $x(n)$, and the output signal by $y(n)$. Then, the system described by input-output relationship $y(n) = e^{x(n)}$ is

   (a) Linear
   (b) Non-Linear
   (c) Both a and b
   (d) All of the above
   (e) None of the above

6. If Z-transform of a signal $x(n)$ is $X(z)$, then Z-transform of $x(n-k)$ is

   (a) $Z^{-k}$
   (b) $Z^{k}$
   (c) $Z^{-2k}$
   (d) $Z^{2k}$
   (e) None of the above

7. A Finite-duration impulse response (FIR) filter has

   (a) Infinite non-zero value of the impulse response coefficients
   (b) Finite zero value of the impulse response coefficients
   (c) Infinite non-zero value of the impulse response coefficients

(d) Finite non-zero value of the impulse response coefficients

(e) None of the above

8. If a signal $f(t)$ has energy $E$, the energy of the signal $f(4t)$ is equal to

(a) $\frac{E}{4}$

(b) E

(c) 4E

(d) 16E

(e) None of the above

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9. Let $\delta(t)$ denote the delta function. The value of the integral $\int_{-\infty}^{+\infty} \delta(t) cos\frac{5t}{2}\ dt$

(a) 0

(b) 1

(c) 2

(d) 4

(e) None of the above

10. Consider an atom as containing a point charge $+Q$ at its center surrounded by a uniform volume distribution of negative charge $-Q$ within a sphere of radius $R$. The magnitude of the electric field at a distance $r$ from the center at a point inside the atom ($r < R$) is

(a) $\frac{Q}{4\pi\epsilon_0}\left(\frac{1}{r^2} - \frac{r}{R^3}\right)$

(b) $\frac{Q}{4\pi\epsilon_0}\left(\frac{1}{r^2} - \frac{r^2}{R^4}\right)$

(c) $\frac{Q}{4\pi\epsilon_0}\left(\frac{r}{R^3} - \frac{1}{r^2}\right)$

(d) $\frac{Q}{4\pi\epsilon_0}\left(\frac{r^2}{R^4} - \frac{1}{r^2}\right)$

(e) None of the above

11. An infinite conducting sheet has a surface charge density of 2 $\mu$Cm$^{-2}$ on one side. How far apart are the equipotential surfaces whose potentials differ by 20 V?
($\epsilon_0 = 8.854 \times 10^{-12}$C$^2$/Nm$^2$)

(a) 177.1 $\mu$m

(b) 177.1mm

(c) 88.5 $\mu$m

(d) 88.5 mm

(e) None of the above

12. In a conducting medium,

$$\vec{H} = \frac{\vec{B}}{\mu_0} = y^2 z\hat{x} + 2(x+1)yz\hat{y} - (x+1)z^2\hat{z} \text{ Am}^{-1}.$$

The current density $\vec{J}$ at $(1, 0, -3)$ is

(a) $9\hat{y}$ Am$^{-2}$

(b) $-4\hat{x} + 9\hat{y}$ Am$^{-2}$

(c) $9\hat{z}$ Am$^{-2}$

(d) $-9\hat{y}$ Am$^{-2}$

(e) None of the above

13. What are the inphase and the quadrature modulating signals $s_i$ and $s_q$, respectively, for a modulated transmitted waveform $s(t) = 2 \times \cos((200\,t + 0.5)\pi)$?

(a) $s_i = 0; s_q = 2$

(b) $s_i = 2\,\cos(100t/\pi); s_q = 2\,\sin(100t/\pi)$

(c) $s_i = 2\,\sin(100t/\pi); s_q = 2\,\cos(100t/\pi)$

(d) $s_i = 2; s_q = 0$

(e) None of the above

14. Suppose a digital communication transmitter sends one of the four signals $s_1(t) = -2 \times \sin(50\pi\,t)$, $s_2(t) = -2 \times \cos(50\pi\,t)$, $s_3(t) = 2 \times \cos(50\pi\,t)$ and $s_4(t) = 2 \times \sin(50\pi\,t)$. What is the modulation scheme used?

(a) Quadrature Phase Shift Keying

(b) Quaternary Frequency Shift Keying

(c) Quaternary Orthogonal Modulation

(d) Quadrature Amplitude Modulation

(e) None of the above

15. A transmitted conventional DSB-FC AM signal is given as $s(t) = 5\cos(2\pi f_c t) + m(t)\,\cos(2\pi f_c t)$. Suppose $m(t) = 3.5\sin(20\pi t)$ is the message signal. What is the power efficiency $\eta$ of this AM signal?

(a) $\eta = 0.6$

(b) $\eta = 0.333$

(c) $\eta = 0.25$

(d) $\eta = 0.2$

(e) None of the above

16. Let A $= \begin{bmatrix} 1 & 2 & -1 \\ 2 & k & -2 \\ 1 & 2 & 2 \end{bmatrix}$ be a given matrix. For rank(A) = 1, k should be

(a) 0

(b) 4

(c) rank $(A) = 1$ for all $k \in R$

(d) It is not possible to get rank(A) = 1 for any value of k

(e) None of the above.

17. Let S = {1, 2, 3, 4, 5} be a given set of numbers. We define a binary relation R on S: $\forall a, b \in S, (a, b) \in R \Leftrightarrow |a - b| < 2$. The binary relation R is

(a) Reflexive, but neither symmetric nor transitive

(b) Reflexive and anti-symmetric, but not transitive

(c) Reflexive and symmetric, but not transitive

(d) Reflexive, Symmetric and transitive

(e) None of the above

18. Let $f : \mathbb{R} \to \mathbb{R}$ be a function defined as $f(x) = |x - 1|, \forall x \in R$. Which of the following statement is true?

(a) $f$ is Continuous and differentiable everywhere

(b) $f$ is Continuous everywhere but not differentiable at $x = 0$

(c) $f$ is Continuous everywhere but not differentiable at $x = 1$

(d) $f$ is Neither continuous nor differentiable at $x = 1$

(e) None of the above

19. If we toss a fair dice twice, what is the probability that the sum of numbers obtained will be greater than or equal to 8, given that the first roll of dice gave the number 3?

(a) $\frac{1}{2}$

(b) $\frac{1}{3}$

(c) $\frac{5}{12}$

(d) $\frac{1}{4}$

(e) None of the above

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20. What is the output of the following C code? Assume all necessary header files are included. int main()
{
int p=5;
int a= p++ - ++p;
printf ("%d%d", a,p);
return 0;
}

(a) -1 7

(b) -2 7

(c) 0 6

(d) -1 6

(e) None of the above